INFORMATION SCIENCES AND TECHNOLOGY

VOLUME I

DOD USER NEEDS STUDY

PHASE I

DOD USER NEEDS STUDY - PHASE I

Lawrence H. Berul, et al

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13. ABSTRACT

An interview based survey of the DOD RDT&E population was conducted to determine how DOD scientists and engineers presently acquire and use scientific and technical information. Depth interviews were conducted with 1375 respondents randomly selected from the 36,000 members of the DOD RDT&E population. The critical incident interviewing technique was used to isolate a recently completed task, and to define the characteristics (e.g., depth, volume, class, timeliness, field media) of the information acquired and used in the performance of that task. A semi-structured interview guide and handbook were developed and used to ensure consistency of question interpretation. A data compilation system and computer programs were developed to compile, analyze, compress, and present the data. Approximately 600 one-way, two-way and three-way tables were prepared to aid in the analysis. These tables and narrative data were analyzed and interpreted, and resulted in a series of findings, conclusions and recommendations.

This report is contained in 2 volumes. Volume I consists of three sections entitled: Management Report, Conduct of Study, and Analysis of Data, plus four appendices entitled: Study Execution, Discussion and Results of Survey Questions, Bibliography of User Studies, and Glossary. Volume II consists of three sections entitled: Interview Guide Handbook, Computer Program Documentation, and Statistical Tables.

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FINAL TECHNICAL REPORT
1151-TR-3

DOD USER NEEDS STUDY

PHASE I

Submitted to

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AUERBACH Corporation • Philadelphia 3, Pennsylvania

FOREWORD

AUERBACH Corporation was awarded a contract (Contract Number SD-219) by the Office of the Secretary of Defense to perform a comprehensive survey of the RDT&E personnel in the Department of Defense to determine how these individuals acquire and utilize technical and scientific information in the conduct of specific tasks associated with their work.

The study was conducted under the sponsorship of the Advanced Research Projects Agency, Office of the Secretary of Defense; administered under the direction of Mr. Fred A. Koether, Director, Technical Information, Advanced Research Projects Agency; and directed by Mr. Walter M. Carlson, Director of Technical Information, Office of the Director of Defense Research and Engineering, Department of Defense.

In addition to the AUERBACH staff utilized in performing this study, outside consultants were employed in specific areas. Dr. John de Cani, of the Statistics Department of the University of Pennsylvania, provided consultation in the statistical aspects of the study; Dr. Herbert Menzel from Columbia University provided inputs for the survey design; and Dr. Robert Sleight and Mr. Kenneth Cook of the Applied Psychology Corporation were consulted in the use of interviewing techniques.

The report is presented in two volumes. Volume I consists of three sections entitled: Management Report, Conduct of Study, and Analysis of Data, plus four appendices entitled: Study Execution, Discussion and Results of Survey Questions, Bibliography of User Studies, and Glossary. Volume II consists of three sections entitled: Interview Guide Handbook, Computer Program Documentation, and Statistical Tables.

NOTE:

The detailed data collected, supplementary computer printouts, and the computer programs developed to compile and tabulate the data have been delivered to the Department of Defense. Persons interested in these items should contact:

Director of Technical Information
Office of the Director of Defense Research
and Engineering
The Pentagon
Washington, D.C. 20301

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SECTION I. MANAGEMENT REPORT

1.1 INTRODUCTION

The Importance of Scientific and Technical Information

The acquisition, use, and creation of scientific and technical information is an integral part of the research, development, test, and evaluation (RDT&E) process. Information is an essential raw material and generally the output of this process. Within the Department of Defense (DOD) alone, approximately seven billion dollars were spent for RDT&E during the 1964 fiscal year. Engaged in this massive effort are some 36,000 scientists and engineers within the Department of Defense and an even larger number in industry. It is therefore not surprising that DOD, the largest sponsor of research and engineering, should be paying increasing attention to the manner in which scientific and technical information is acquired, processed, packaged, delivered, and used by its engineers and scientists.

The Information Problem

The "information problem" is generally attributed to the exponential growth of the technical literature. In reality, there are a series of information problems affecting different groups at different levels. For example, the librarian and documentalist are faced with the problem of managing this rapidly growing volume of information. Users are faced with the problem of having to be more selective in their information intake. The technical man no longer can keep up with all the literature in his field, nor even read all of the material which may be relevant to a particular task.

Further, each time a new technology goes through a period of rapid growth, the edges of disciplines appear to become more blurred, whole new areas spring forth, and the semantic distortion among author, systems of storage and retrieval, and user become more and more involved. Under such conditions, the technical man is frequently unaware of prior work and repeats tasks which have already been accomplished.

The magnitude and importance of the information problem have resulted in the establishment of a number of new information activities. Most of these are oriented around the announcement and distribution of documents — usually technical reports. More recently, the emphasis has shifted to technical information analysis centers which also perform the functions of evaluation, correlation, and synthesis of information.

It is not at all clear, however, that these information activities are, or will ultimately be, effective solutions to the information problem since the needs of the ultimate user are not adequately understood.

The present situation is vividly portrayed by Alan Rees of Western Reserve University in an article in Information Retrieval in Action:[1]

> "The information retrieval field has been plagued for many years by busy people spending large sums of money, designing — or attempting to design — phantom systems for non-existent people in hypothetical situations with unknown needs. It is not surprising that large numbers of theorists, hardware peddlers and promoters have ignored the user, with the result that the needs of users are conspicuously absent in many discussions on system design and operation."

The goal of future information systems should be to provide the right information to the right person, in the right form, at the right time, and at his work station. To achieve this goal, it is first necessary to define the user's need for acquiring and utilizing technical information.

Previous User Studies

User needs are neither broadly known nor well understood, despite the fact that numerous scientific and technical use studies have been conducted and reported in the literature. The Bibliography included in Appendix C of this Volume lists

---

(1) Rees, Alan M., "Information Needs and Patterns of Usage." Information Retrieval in Action, Western Reserve University, Cleveland (1963) pp. 17-23.

nearly 700 titles of references dealing with earlier or contemporary user studies. While a majority of these studies appear to have been well conducted and have produced valuable information for specific purposes, they do not, individually or collectively, provide sufficient general criteria for defining the specific information needs of any broad segment of the DOD RDT&E community.

There are a number of reasons for this:

(1) A large number of the studies were conducted for specific purposes in unique environments; e.g., studies concerning the journal reading habits of various groups, the frequency of use of a particular library, the readership of specific publications and the media or channel used to acquire information.

(2) Many of them have been concerned only with scientists in a research atmosphere, usually in an experimental laboratory environment.

(3) Few studies have been concerned with engineers, particularly those with a product or administrative orientation.

(4) Most of the studies have concentrated on the users' information needs in terms of the types of packages they use, e.g., journal, rather than the information they need.

(5) Wide differences exist in the sampling, interviewing, and data analysis techniques used, making correlation of results difficult or impossible.

Consequently, few of the studies provide a reliable base for extrapolation to general conclusions about the information needs of the DOD RDT&E community.

1.2 STATEMENT OF STUDY OBJECTIVES

The primary objective of the DOD user need study was to collect and analyze a statistically significant data base on how DOD scientists and engineers presently acquire and utilize technical information in the performance of their tasks.

The data base would serve to answer such questions as:

- Who is the user?
- In what technical activity is he engaged?
- What is most frequently the first source to which the DOD technical man turns for technical information?
- What class of information does this technical man use?
- How much of the available relevant information does he want?
- Does he need a detailed analysis of the information?
- How quickly does he need the information?
- Does he have difficulty finding information?

Scope

The scope of the study is defined by Article I of the contract schedule as quoted below:

> "ARTICLE I. SCOPE. The Contractor agrees to conduct a study relating to the availability of scientific information to technical personnel involved in defense activities. In connection therewith, the Contractor will perform the following tasks:
>
> "1. Establish objectives, procedures, and ground rules under which the study is to be made through discussions with the personnel of the Office of the Director of Technical Information, Office of the Director of Defense Research and Engineering.
>
> "2. Analyze the population under study using tab cards and other data provided by the Department of Defense, and develop sampling procedures and design the sample size.
>
> "3. Develop for the interview survey, necessary guides, procedures, materials, and administrative controls, and train interviewers in cooperation with DOD personnel, if deemed necessary.

"4. Select and train the survey team. The Department of Defense may, at their option, include up to five (5) DOD personnel in the training program.

"5. Conduct at least one pilot survey of the fifty (50) or more interviews of DOD scientific and technical personnel within the Washington, D.C., area. Additional pilot surveys of up to two hundred (200) interviews may be conducted, with the approval of the contract scientist, as required, to properly prepare for the main survey.

"6. Analyze the results of the pilot surveys, revise the interview guide and procedures as required, select the specific people to be interviewed according to the sampling procedure, and make final preparations for the main survey.

"7. Conduct a survey of DOD scientific and technical personnel according to the procedures developed in the above tasks. Contractor shall conduct not less than twelve hundred (1200) interviews. The total number of formal interviews, including pilot and main study, will not exceed eighteen hundred and fifty (1850).

"8. Under the direction of the Director of Technical Information, perform the preliminary analysis of the survey results which will provide the basic statistical information and a summary of the nonquantitative results."

The study was not intended to develop specifications for a DOD-wide information system. Such a task would necessarily require many additional types of information which are far beyond the scope of this effort. It was intended, however, to be a first step toward this larger goal, as it forms the basis for further analyses and investigations into the information processes and needs of the RDT&E community within the Department of Defense.

1.3 DATA BASE DEVELOPED

A scientifically designed survey methodology was employed to gather data. A random sample of 1,375 DOD RDT&E personnel was selected and interviewed by the survey team. From the sample data, a large data base was compiled. This data is available in several forms.

(1) Approximately 600 selected tables which combine answers to either one, two or three questions viewed together.

(2) The completed interview guides, as submitted by the survey team interviewers.

(3) Coded data from the completed interview guides stored on standard EAM punched cards.

(4) Coded data from the completed interview guides stored on magnetic tape, which is capable of being run on the IBM 1401 computer. Numerous tables of analyzed data, which combine answers to either one, two or three questions viewed together, are also available on magnetic tape.

(5) Standard EAM punched cards containing narrative responses to selected questions.

Various computer programs were prepared and used for statistically processing and formatting the data. The data and programs are available for further investigation and analyses.

1.4 FINDINGS

The following findings represent some of the more significant statistical results obtained from the data. For ease of presentation, some of the data categories have been pooled. Detailed breakdowns of the data are presented in Section III and in Appendix B.

Characteristics of the Population

Little data was available prior to this study about the characteristics of the DOD RDT&E population. This was one of the primary reasons for using a random rather than a stratified sampling technique. The use of a random sample has produced a comprehensive picture of the RDT&E population.

The educational background of the DOD RDT&E population is heavily oriented towards the engineering sciences, with 51 percent of all degrees within the field of engineering.

The population is well educated as 90 percent have at least a bachelor's degree and 25 percent have an advanced degree. The educational distribution of the population is shown in Figure 1-1.

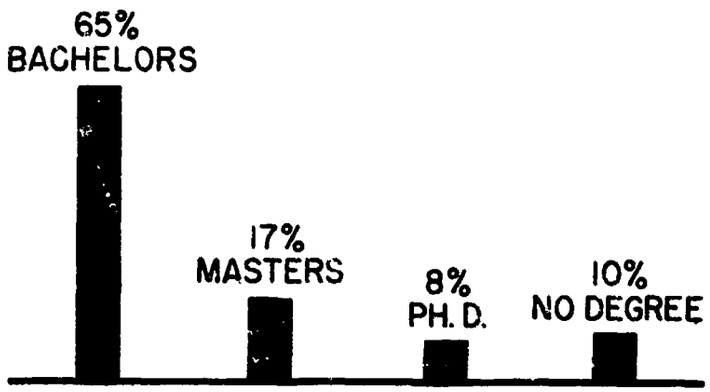

Figure 1-1. Highest Degree

The population is primarily civilian with only 15 percent being military. The median age was found to be 40 years.

Consistent with the educational background, about half of the job classifications (MOS) are in engineering and one quarter in the physical sciences. The distribution of technical activities in which the DOD RDT&E population is engaged was found to be as shown in Figure 1-2.

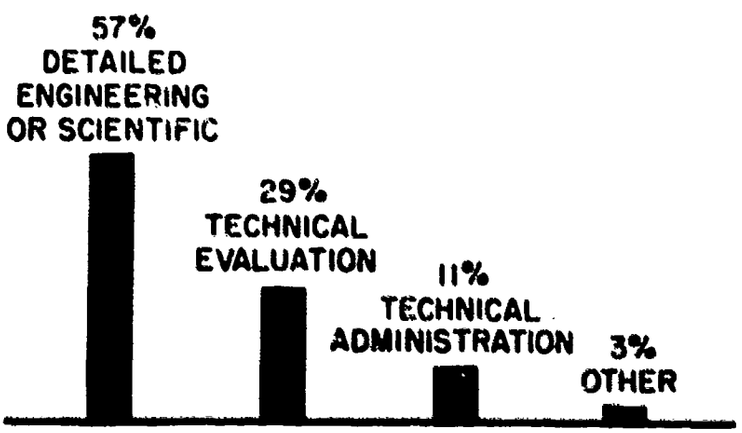

Figure 1-2. Type of Activity

Characteristics of the Tasks

The DOD technical population was found to be engaged in a broad spectrum of technical activities in all scientific fields, with the major emphasis in the engineering sciences.

Most of the task assignments identified involved relatively limited effort (i.e., less than one man-week); the more extensive tasks were generally research-oriented. The technical character of the tasks was distributed as shown in Figure 1-3.

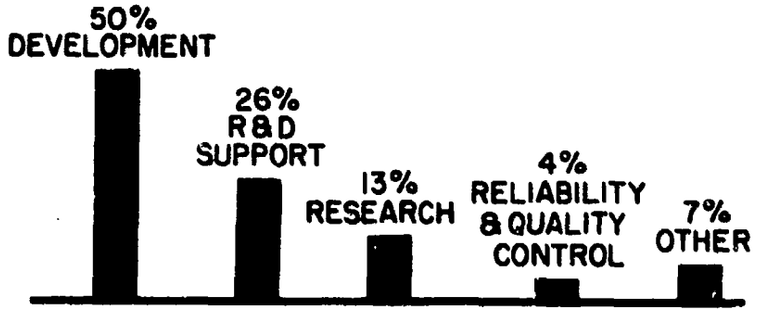

Figure 1-3. Kind of Task

The major output of a task was more frequently a finding or recommendation rather than a decision. The distribution is shown in Figure 1-4. The primary mode of presenting task results was in writing (68 percent), as compared to oral or any other form.

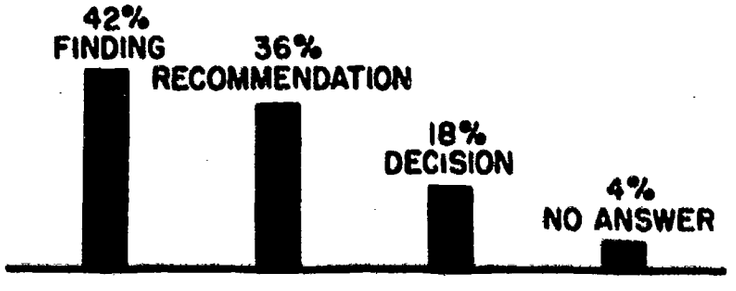

Figure 1-4. Major Output of a Task

Characteristics of the Information Acquired and Used

The major emphasis in the study was on the characteristics of the information acquired and how it was used. The more important findings in this area are as follows:

(1) Classes of Information Used. The most frequently used category of information can be termed "engineering data," particularly the class entitled performance and characteristics and specifications (42 percent).

The relative usage of all the various classes of information in the completion of the sampled tasks is shown in Figure 1-5.

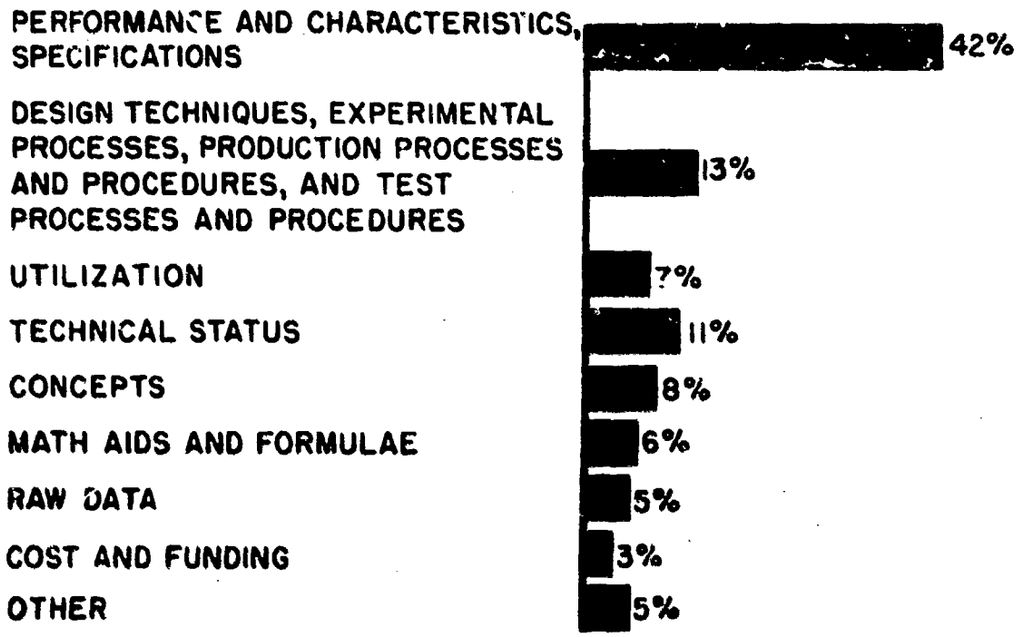

Figure 1-5. Distribution of Classes of Information Used

The distribution of information by class, as shown above, appears to be independent of either the characteristics of the task or the characteristics of the person interviewed. That is, the relative distribution by class does not significantly vary with the person's MOS, the type or field of the task, the length of task, or the task output. There are a few minor variations to this general finding in the fields of ordnance, medicine, research, and aircraft, which are discussed in Section III.

(2) Volume of Information Used (Recall). How much of the available material was the user exposed to for a given task related information requirement? Only occasionally (16 percent) did he see (or believe he saw) all of the available material (see Figure 1-6).

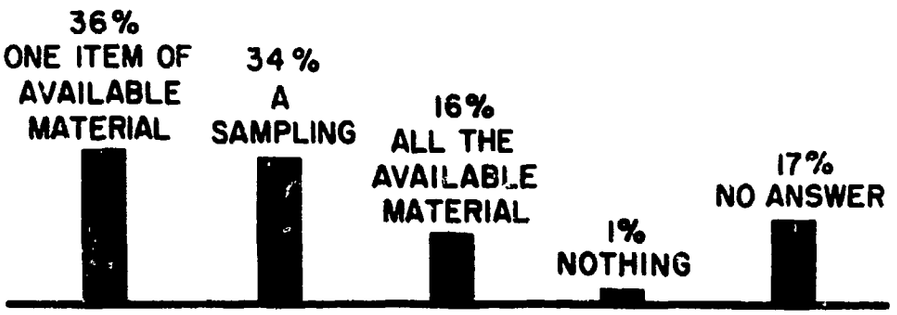

Figure 1-6. Volume of Information Used

(3) Search Aids. Would the user have found title listings or abstracts useful to read first in order to select chunk* material to read in detail? This question was asked only if the interviewee indicated a need for a large volume of information on the particular chunk. The specific responses to this question were distributed as shown in Figure 1-7.

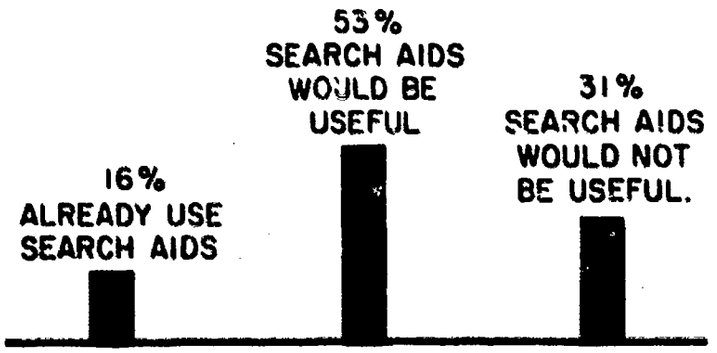

Figure 1-7. Utility of Search Aids

* A chunk is the smallest unit of task required information which would lose its identification and meaning with respect to the task if segmented further.

(4) Retrieval Time. Information was generally obtained in less than the allowable time, as shown in Figure 1-8. For example, in only 18 percent of the cases was the information needed in less than one day, whereas it was actually obtained in less than one day in 41 percent of the cases.

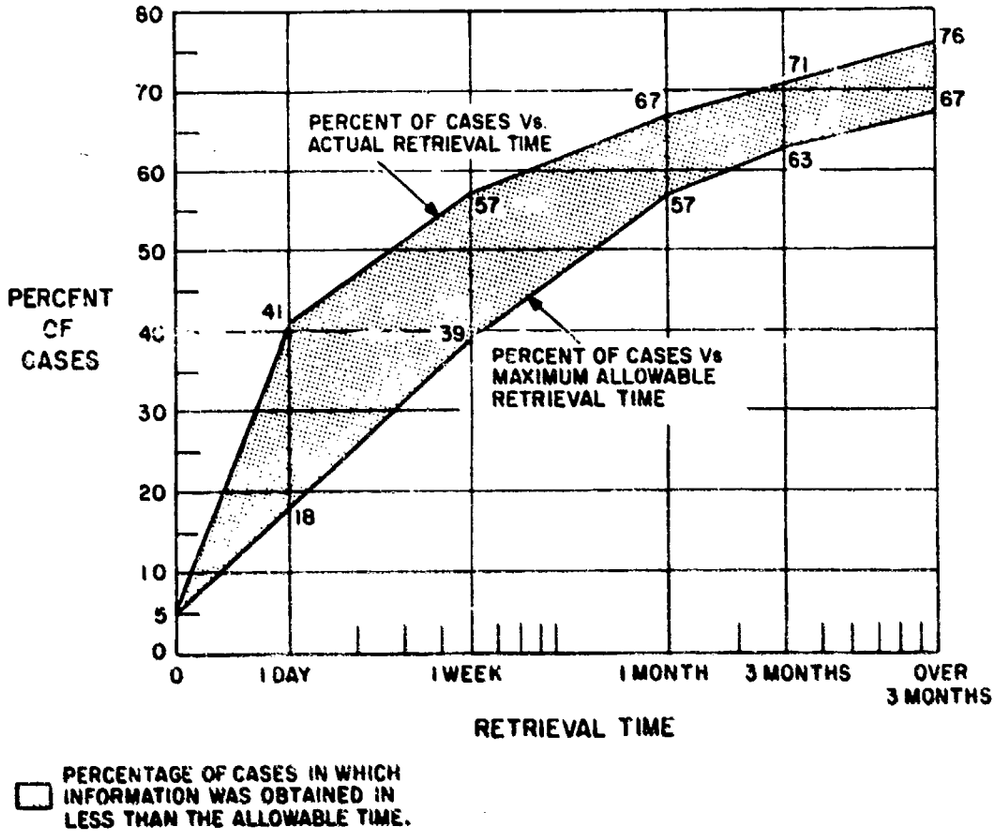

Figure 1-8. Retrieval Time

These distributions appeared to be independent of the media in which the information was obtained or desired. The time requirement observed may not be too significant because people tend to adjust their time requirements for information to the existing system.

(5) First Source of Information. In more than half of the task related searches, RDT&E personnel utilized colleagues, personal files, and local departmental sources as their first source of information as illustrated in Figure 1-9. Furthermore, regardless of the first source contacted, this source completely satisfied the particular information requirement 39 percent of the time. Thus, a convenient and responsive external first source is an important element of the RDT&E information system.

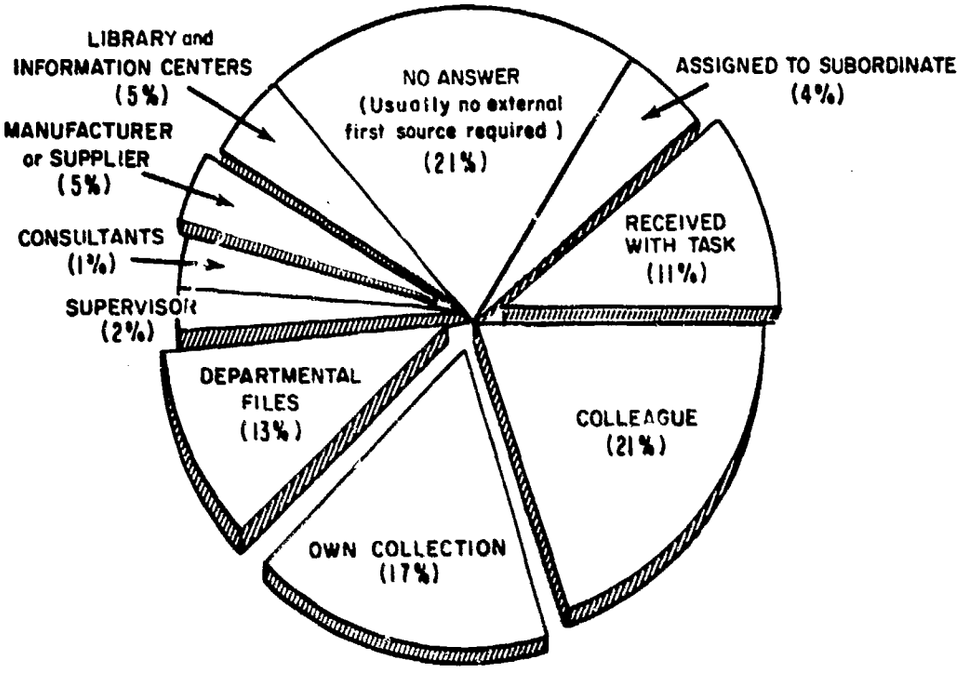

Figure 1-9. First Source of Task Related Information

(6) Media. Oral communication was found to be a significant vehicle for acquiring task related information. Nearly 30 percent of all such information was acquired by this medium. This is consistent with the findings that a colleague is an important first source. The technical report, which provided 16 percent of the information requirements, was the most frequently used written medium.

(7) Depth of Information. Depth was defined as either a "once over lightly," such as a bibliography which provides indicative abstracts of possibly relevant documents, or a "detailed analysis," such as a comprehensive state-of-the-art review of a technical field. A "specific answer" was defined as a subcategory of "detailed analysis."

It was found that the user far more frequently required a "detailed analysis" or a specific fact than a "once over lightly" of a subject. Figure 1-10 shows the distribution for the depth of information received and wanted.

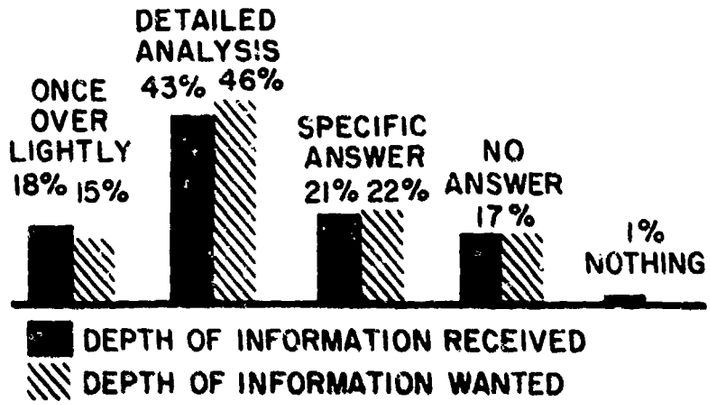

Figure 1-10. Depth of Information

Use of DOD Information Services

Several questions were directed specifically to the use of DOD information services. It was found that these services were used by only about half of the population, and were rarely relied on as a first source of information. The RDT&E personnel who utilized DOD information centers were generally satisfied with the services they received. A considerable proportion (21 percent) of RDT&E personnel were unaware of the existence of the Defense Documentation Center (DDC). A similar proportion (19 percent) were unaware of the existence of any one of 33 specified DOD specialized information centers. It was observed, however, that many users may have actually utilized the services provided by these organizations without being aware that they were doing so. Local libraries secure services for a user from DDC or DOD information analysis centers and sometimes circulate their current awareness materials, such as DDC's Technical Abstract Bulletin (TAB), in other than their original form. As a result, the user may not know that this information came from DDC.

Satisfaction With Ability to Obtain Information

The majority (67 percent) of DOD RDT&E personnel stated that they had no serious trouble obtaining or locating information needed to perform or conclude their tasks during the last year.

It is significant, however, that as many as 27 percent of the population stated that they did have problems in obtaining or locating information. One commonly encountered suggestion, by the respondents who did claim to have information problems, was that DOD publish and distribute a directory or register of the R&D effort currently under way throughout DOD.

1.5 CONCLUSIONS

The above findings represent the most significant statistical results of the study. They have been presented essentially without comment or interpretation. The conclusions which follow attempt to interpret both the meaning of some of these results and their significance to DOD.

The reader may observe that many of the findings and conclusions drawn from this study are in agreement with widely held intuitive opinions of many knowledgeable individuals in the information field. The data developed in this study confirms and answers once and for all many of these opinions, and, therefore, takes them out of the realm of conjecture.

Importance of Engineering Data

The universal use of engineering data throughout the RDT&E community is a measure of its importance to the RDT&E effort. It is particularly noteworthy that forty-two percent of the users required specifications and performance and characteristics data in support of their tasks. Continued improvement of the methods for preparation, acquisition, classification, indexing, storage dissemination, retrieval, and correlation of such engineering data is clearly warranted.

Significance of Local Environment

The user tended to rely heavily on his local environment (51 percent) as a first source of information, which completely satisfied his particular information requirement in 39 percent of the cases. This finding tends to confirm the existence and significance of an informal information system consisting of the user's personal files, his colleagues, and other local sources of information. The features of this informal information system, which the user apparently considers important, are: convenience, responsiveness, and the ability to conduct a dialogue (interplay and feedback). The user apparently wants to deal with a system wherein he can personally explain, clarify, and modify his requirements, and he can expect in response the right information in the right amount, in the right form, and in the time required.

The fact that local sources of information are heavily utilized may also indicate that DOD is well managed in that it properly assigns tasks to that organization which has adequate background and experience to achieve the desired technical objectives.

Importance of the Information Analysis Function

The high proportion (68 percent) of requirements for either a "detailed analysis" or "specific answer," rather than a "once over lightly" (15 percent), underscores the importance of the information analysis function. The user apparently wants a detailed analysis or specific answer more often than a series of abstracts to documents which may be relevant to his question. The recent emphasis on the establishment of additional formal DOD information analysis centers, as evidenced by DOD instruction 5100.45 entitled Centers for Analysis of Scientific and Technical Information, indicates a recognition of the importance of this function.

Use of the Formal Information System

It was found that the components of the DOD formal information system (technical libraries, DOD information analysis centers, and Defense Documentation Centers) were not widely utilized. One reason found for the lack of widespread use was a lack

(4) A serious information problem may exist with certain types of information, but not with others. For example, one area identified by those who claimed to have a problem was the need for information on current R&D projects in progress.

1.6 RECOMMENDATIONS

The findings and conclusions, which have been developed from an analysis of the data, provide the basis for a number of recommendations. Since the study objective was to develop a broad data base on information use patterns within the DOD RDT&E community, and not a blueprint for DOD-wide information systems, it is clear that no drastic or precipitous actions are warranted directly as a result of this study. Much more still needs to be learned about the user as well as about DOD systems.

The recommendations primarily call for the conduct of specific studies and experiments in those areas identified as significant by the study. The experiments should be conducted both to study the user in greater detail and to determine the feasibility of specific system improvements, their potential payoff, the problems encountered, and the details of their solution. These experiments should be set up at a small number of installations in a well-controlled environment to assess their effectiveness, as well as to gain a more complete understanding of the user and his information requirements.

Improvements to the Local Environment

The study demonstrates the importance of the local environment and confirms the existence of an informal information system. The following recommendations would tend to strengthen and perpetuate the informal information system, and, if properly implemented, could also strengthen the formal information system. Recommendations concerning the interface relationships between the formal and informal information systems are given on page 1-21.

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(1) Local Skills Inventory. Since the user prefers to ask a knowledgeable colleague for information, it may be useful to expand the number of colleagues he has access to by providing each user with a skills directory of the personnel at his particular installation.

An experimental directory should be developed which would be organized by skill area, and would list such items as the individual's name, telephone number, and experience in the subject area. The directory would be distributed to all RDT&E personnel at an installation. Encouragement would be given to individuals to contact the listed personnel when information in a particular skill area is required.

Such a directory would serve to extend the concept of a knowledgeable, available colleague who can provide rapid feedback. It would be relatively simple to develop and maintain and yet might make a significant impact upon the ability of RDT&E personnel to acquire and utilize information. If the experiment proves successful, this concept could be extended throughout DOD on a local basis. Ultimately, the local skills inventories could be integrated into a central DOD-wide skills inventory system. Such an inventory would be useful to management for making proper task assignments at the DOD level as well as at the agency and local levels. This inventory need not be widely distributed. However, a user could make inquiry of the central system where he needed other than local skills information.

(2) Improved Personal Files. RDT&E personnel and departmental organizations should be encouraged to organize and maintain their own files in a more effective manner. This would tend to decrease the access time to desired information.

An experimental training course or guide might be developed to bring to the attention of RDT&E personnel techniques currently available to assist them in better organizing their personal files. Improved filing systems and filing aids should be developed and tested on an experimental basis. Consideration might further be given to determining the interrelationship among personal files, departmental files, and information systems since there is a degree of overlap between the classification and indexing problems at each of these points.

(3) Information Specialists. It was observed that an information specialist was being utilized, in a number of DOD RDT&E installations, to both anticipate and fulfill the information requirements of the technical staff. The information specialist frequently acts as an intermediary between the user and the formal information system. It is recommended that an experimental study be conducted to evaluate the utility of an information specialist, particularly in relation to his function of creating new information (by information synthesis and correlation), and to his responsibility for monitoring and improving the user's process of information acquisition, use, and generation.

Improvements to the Formal Information System

(1) Publicity and Training. To increase the utilization of the DOD formal information system, the technical community should be made aware of the various services available. This is necessary even if the community usually obtains these services through an intermediary, such as an information specialist or a local library. Consequently, an experimental public relations program is recommended to promote selected DOD information services.

An experimental training program should also be prepared which would serve to provide general instruction in the use of various DOD information centers and services. A more comprehensive training program and handbook should be prepared (for librarians and information specialists) on the details of how to use the various formal DOD information services. This would supplement and reinforce the more general training program for the technical man.

(2) Engineering Data Systems. The findings and conclusions suggest that greater emphasis should be given to systems for handling engineering data, such as performance and characteristics and specifications. Considerably more must be known about the engineering data requirements of the user before effective engineering data systems can be designed.

It is therefore recommended that further DOD user studies be conducted which focus more specifically on engineering data requirements, particularly on the specific classes and sub-classes of engineering data, and the degree of analysis and specificity required.

It is also recommended that a thorough systems analysis and evaluation be made of existing DOD engineering data services to determine whether any significant improvements can be made at nominal cost.

Further, it is recommended that the computer mechanization possibilities of an engineering data system be investigated. Careful consideration should be given to developing means for easy access to mechanized engineering data systems. For example, the utility of a flexible on-line query system might be studied. With a flexible on-line query system, the user could interact more effectively with a mechanized information system, which, in essence, would be acting like a very knowledgeable colleague.

(3) Utility of Search Aids. An experiment could be conducted to determine if increased use of abstract journals indexes, title lists, and similar aids by the technical man would materially aid him in selecting and acquiring technical information. A training program on the available aids and their use could be developed. This would be accompanied by supplying the installation with appropriate current awareness and search aids, and, at the same time, providing the necessary support capability to allow the users to obtain quickly the required material. At the end of a given period of time, the use and application of current awareness and search aids could be examined to obtain a qualitative measure of their utility.

(4) R&D Projects Directory. It is recommended that the development of the DOD R&D project reporting system (DOD instruction 7720.13) be accelerated and enhanced.

Suggestions to this effect were received from a number of the RDT&E people interviewed. In particular, it is recommended that a directory of R&D projects in progress, arranged by subject-category, be published and widely distributed throughout DOD, within security limitations. Separate cumulative editions might be prepared for each subject-category. The system development should be coordinated with other groups involved in this problem, such as the Federal Clearinghouse for Scientific and Technical Information, which plans to publish a government wide directory of R&D projects in progress, and the Science Information Exchange.

A major difficulty with such a system is obtaining complete and accurate disclosure of R&D projects. To avoid the problems associated with inaccurate disclosure, the system must provide for validating the reported information, perhaps by reference to collateral documents such as technical reports, proposals, and the like.

Relationship Between Formal and Informal Information Systems

It is recommended that a study be conducted to define more clearly the relationship which may exist between the formal and informal information systems. For example, DOD current awareness services, including announcement journals and initial and secondary distribution of technical reports, contribute to the utility of the local environment. In addition, there is a degree of overlap between the indexing of a report by an information center and the filing of that same report in a personal or departmental file.

The study should determine what functions are presently performed by the informal system and what functions are performed by the formal system. The areas of overlap should be isolated. The degree of dependence of the informal on the formal system should be identified and the points of interface clearly defined. Finally, the major role of each component of the overall information system should be determined. For example, one component may produce information, another may be the wholesaler, while still another may act as the retailer. The overall system also includes producers, wholesalers, and retailers of specialty products and services. The products and services at each level of distribution should be identified, analyzed, and precisely described.

Experimental Information System

It is recommended that an experimental information system be set up to simulate the features of various types of information systems, including the specialized information center, the documentation center, the local library, the information specialist, and others.

The primary objectives of such an experimental system would be to observe user habits and to accumulate detailed data on such items as: (1) traffic volume, (2) response time, (3) vocabulary, (4) type and complexity of questions, (5) the need for information or data, and (6) type of task on which information is required.

A further objective of this experiment would be to determine the type and degree of mechanization that might practically be effected to support the user.

Some of the above objectives are difficult to accomplish, and can only be achieved by people who are in direct communication with the user. Consequently, the systems would rely heavily upon people to perform the services desired by the user, including many services which might more appropriately be mechanized. A sufficient number of people should be made available to respond immediately to user requirements. The people operating the experimental system would also provide the interface with other information centers, which may be unknown to the user.

The informal information system apparently has the characteristics (convenience, responsiveness, and the ability to conduct a dialogue) desired by the user. A reasonable question to ask is whether an enhanced formal information service which had these characteristics would be useful and utilized extensively. To develop a comprehensive system employing the aforementioned characteristics for the entire DOD RDT&E population would require a major capital expenditure. It is therefore necessary that the utility of such a system be determined, to the degree possible, without a full-scale implementation.

Measurement of Information

From the outset of this study, it was recognized that one of the most severe handicaps was the unavailability of objective and precise techniques for measuring information. Measures are needed for describing information value, depth, relevance, recall or volume, specificity, and packaging. This problem is not unique to this study; rather it is a problem which is impeding the state of the art of the entire field of information storage and retrieval. Until measurement techniques are developed, future studies that examine non-quantifiable information will continue to be hampered. This study developed and used the concept of a "chunk of information" as a subjective measure of information. This concept, although not an objective or precise measure, was found to be quite useful since no existing measures seemed to serve the purposes of this study. Because of the urgency of this problem and the paucity of knowledge on this subject, we recommend that DOD support basic research work toward developing useful techniques for measuring information.

1.7 STUDY LIMITATIONS

In accordance with the study objectives, a broad data base was compiled and an analysis of the data made. The data base will provide the basis for further analysis, including the testing of new hypotheses which stem from a study of this report.

In making further analyses of the survey data, the reader should be aware of the study limitations. The study was broad in scope and dealt with a heterogeneous inter-disciplinary population engaged in a wide variety of tasks. However, the sample size was sufficiently large that meaningful subsets of the population were able to be examined. Because of the breadth of the study, it was not possible to examine each specific subset of the population to a maximum degree of depth. The scope of the study, however, has enabled us to develop a comprehensive picture of the information patterns of the entire DOD RDT&E community.

Considerable care was taken to minimize bias in the data. To this end, a moderately structured interview guide and interview handbook were prepared and utilized to increase the consistency of question interpretation and the resultant responses. Interviewers with scientific and technical training and experience were selected and thoroughly trained in the purpose of the survey and in the interviewing techniques employed. The sample size was sufficiently large that the sample characteristics will differ from those of the population by less than 2.7 percent, in 95 out of 100 cases. Standard statistical tests such as the Chi-Squared test were applied where appropriate. A critical incident interviewing technique was employed to identify the information needed or used for a recent specifically defined task, rather than rely on general opinions and recollection of distant happenings.

In spite of the above precautions, there are still a number of limitations to the data and possibilities of bias. Several of the questions produced marginal results because of their subjective nature, or because the answer categories did not prove to be mutually exclusive. These limitations are noted in Appendix B in the discussion of the responses to each question. The scientist or engineer may be subconsciously biased against formal information systems because he may fear losing his intellectual freedom, or having to "pay" for such formal systems by a corresponding decrease in his budget.

The study did not cover the user's current awareness patterns to any significant degree. During the course of the interview guide development, it was determined that current awareness questions could not be properly handled because the type of questions required would be inconsistent with the critical incident technique. It was also felt that personal interviewing was not the most effective means for gaining insight into current awareness patterns. Close-up observation and monitoring of the information activities of a segment of the RDT&E population may be the only reliable way to obtain such insight. This problem was brought to the attention of the DOD and it was decided that specific questions on current awareness would be omitted from the study. It should be stated here, however, that current awareness needs are important. Consequently, the DOD should direct itself to the problem of developing appropriate methods and surveys to determine the current awareness patterns and needs of the technical community.

This study represents a significant step towards a better understanding of the user requirements for scientific and technical information. More must be learned before we will be able to design responsive information systems which adequately meet the actual needs of the user. We should study in more detail the specific requirements of particular segments of the DOD population for engineering data, because of its relative importance to the entire RDT&E effort. We must study the relationships between the informal and formal information systems to determine where and how the various information processing functions are best performed. Finally, we must determine how current awareness information is obtained and the relationship between current awareness and retrospective searching of local or personal files.

SECTION II. CONDUCT OF STUDY

2.1 INTRODUCTION

This Section describes the conduct of the study in sufficient depth to provide the reader with the background information necessary to interpret properly the various analyses of the data presented in Section III and Appendix B of Volume I, and in Section VI of Volume II. A more detailed discussion of the study execution and the methodology employed is presented in Appendix A of this volume.

The various steps in executing the study are shown in Figure 2-1. The main path of the study is indicated by the heavy arrow. Descriptions of the various stages are presented in the subsequent paragraphs.

2.2 DEVELOP STUDY PLAN

The first step in the study process was to develop an overall plan. The planning effort resulted in initial decisions which ruled out certain types of survey methods such as mail questionnaires, telephone questionnaires, or a diary method.

Criteria and procedures were established for selecting and training interviewers. Philosophies were also developed covering sampling methods, interview techniques and a method for testing them, survey administration, data compilation, and methods of analysis.

2.3 REVIEW PREVIOUS USER NEED STUDIES

Early in the study, a comprehensive bibliography of previous and contemporary user need studies was developed. The references were reviewed for ideas or techniques which might be applicable to the DOD User Need Study. The primary value of this review was identifying the problems which may arise and the limitations of most of the other studies. A bibliography, which includes a categorization of these studies, is presented in Appendix C of this volume.

It was found that many earlier user studies suffered from the weakness of being based on the opinion of the user. The problem is that the user may not have an adequate basis for rendering a reliable opinion as to the types or characteristics of information services, since he may not have had any direct experience with them.

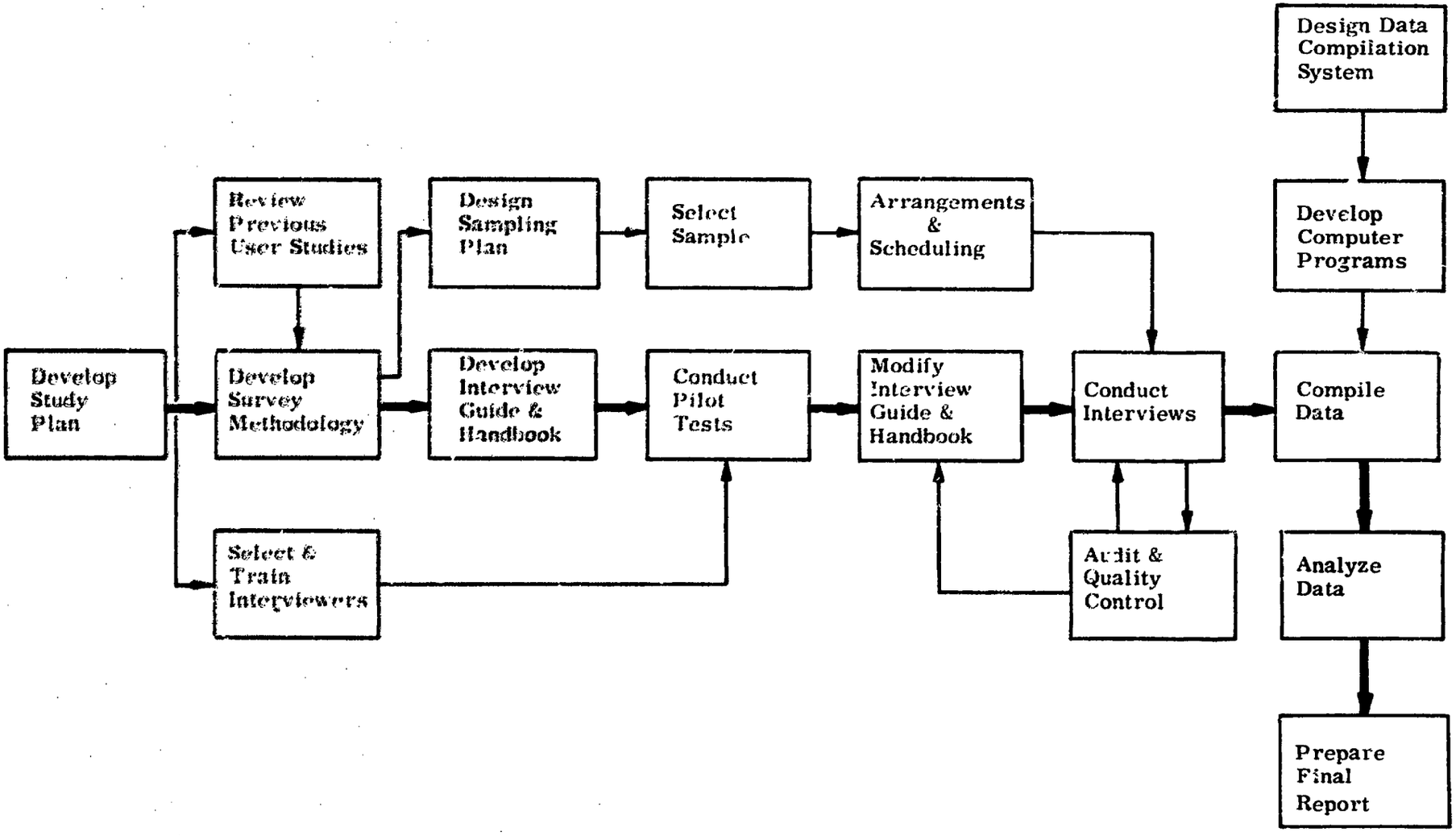

Figure 2-1. Study Process.

It was therefore decided at the outset to make sure that the study would not become an opinion survey. This objective was accomplished by directing most of the questions to the subject of what information was actually used to perform a recently-completed task. Relatively few questions were concerned with defining the kind of information, product, or service the user might like to have.

2.4 DEVELOP SURVEY METHODS

A key feature of the survey methodology was the application of the critical incident interviewing technique. This technique provides that a specific incident be isolated, in this case a recently-completed task, and, through a series of questions, the attributes and characteristics of the information actually utilized in the performance of this particular task are defined. To provide a basis for analysis of the details of the critical incident, other questions are posed to gain insight into the respondent's background and some of his general information gathering habits.

2.5 INTERVIEW GUIDE AND HANDBOOK

A semi-structured interview guide was developed to implement the critical incident technique. It is important to emphasize that an interview guide is quite different from a questionnaire in that an interview guide serves primarily to remind the interviewer of the intent of the questions being asked. Because of the complex nature of the subject matter, it was often necessary for the interviewer to explain, in his own words, the intent of the questions to the interviewee. The structured portion of the guide served two purposes: first, it allowed for categorizing the responses to certain questions; second, it allowed for simplified recording of the responses directly on the guide itself by entering a single letter or number in a designated block. The unstructured portion of the guide allowed the interviewer to probe particular subject areas in greater depth, and record the responses in narrative rather than coded form. The subjective data produced has proved to be very useful in identifying new or unexpected phenomena.

An interview guide handbook was developed and compiled both to aid in the training of interviewers, and as a working tool to help the interviewer in actually conducting depth interviews. A complete copy of the interview guide and handbook is included as Section IV in Volume II of this report. The interview guide handbook contains sections on how to set up interview appointments and how to conduct the interview itself. It also includes supplemental material needed to explain or clarify particular questions. For example, it includes a list of specialized information and data centers. The handbook also explains the

purpose of each question in the interview guide and provides necessary back-up material sometimes needed by the interviewer to communicate the intent of the question and the meaning of the answer categories to the interviewee.

2.6 INTERVIEWER SELECTION AND TRAINING

It was deemed essential that mature and personable people, having a scientific or technical background, should be utilized as interviewers; therefore, they were selected on the basis of the following qualifications:

(1) A scientific or technical background.

(2) A high degree of intelligence.

(3) A high degree of responsibility.

(4) A pleasing personality.

(5) Ability to quickly establish rapport.

(6) A high degree of self-sufficiency and the ability to direct a conversation.

It was necessary to thoroughly train the interviewing team in the purpose of the survey and the actual technique to be employed. In the initial stages the training was extensive. As the training became more highly formalized, the interviewers were able to be trained in a two-week period. The two-week program consisted of four days of formal classroom training (including demonstration interviews), and five days of practice interviewing in the field, under observation of the training specialist and usually one other student interviewer.

2.7 PILOT TESTS

A series of test interviews was conducted to test all aspects of the interview guide and interview procedures.

A pre-pilot survey consisting of 18 test interviews was conducted with technical personnel at AUERBACH, the Frankford Arsenal, and the Philadelphia Navy Yard. The actual pilot survey consisted of 73 interviews with personnel selected by DOD, all of whom were located in the Washington area.

The pilot tests resulted in improvements to all aspects of the survey technique, and in significant modifications to the interview guide and handbook.

An important result of the pilot test was the conclusion that specific questions relating to current awareness patterns should not be included in the survey. It was found that such questions were generally incompatible with the critical incident method being utilized to identify task related information requirements.

2.8 SAMPLING PLAN

The sampling approach taken during Phase I was to select a simple, random sample of approximately four percent of the RDT&E population. The procedure first involved sequential numbering of 36,000 population cards, taking 3,000 random numbers from a table of random numbers, and selecting the cards in the population deck which matched the random numbers. After eliminating duplicates, about 2,700 cards remained. To reduce this number to the desired sample size, approximately one-half of the resulting 2,700 cards were randomly chosen. The sample cards (selected in the above manner) were sorted by installation for convenience in scheduling.

While other sampling techniques might have provided greater economy or precision, the simple random sampling method was selected for very good reasons. The major reason was that sufficient data describing the population characteristics were not readily available to allow for any meaningful stratification of the sample. As a result of using a random sample, a comprehensive picture of the RDT&E population was able to be developed. Further, the sample size was sufficiently large that the information patterns of meaningful subsets of the population were able to be analyzed.

2.9 SURVEY MANAGEMENT

A number of significant administrative problems had to be solved to facilitate the conduct of the study, including efficient scheduling, developing effective means for obtaining the cooperation of those to be interviewed, handling missed interviews, and the like. These are discussed in Appendix A.

2.10 CONDUCT OF INTERVIEWS

The survey consisted of 1,375 personal in-depth interviews of the total DOD RDT&E population. Each interview lasted approximately two hours. The interviews were conducted in private to assure confidentiality and to prevent bias.

The principal parts of the interview were:

(1) Information pertaining to the respondent.

(2) Task definition and isolation.

(3) Identification of required chunks of information.

(4) Questions concerning the acquisition and use of chunks.

In addition to these principal parts, other questions were asked about the respondent's use of certain formal information services and questions concerning his general ability to obtain information. These questions were asked toward the end of the interview and were intended to measure the use of DOD formal information services, as well as to determine the respondent's satisfaction with the services available to him.

2.11 AUDIT AND QUALITY CONTROL

To assure consistent high quality data, a number of audit and quality control provisions were made. First, all of the completed interview guides were reviewed for completeness, consistency, overall logic, and the appropriateness of the alphanumeric coding. In addition, occasional field spot checks of actual interviews were made by the analyst, the training specialist, or the project engineer. As problems were encountered, feedback was provided to the interviewers with suggestions for their solution.

The interview guide itself, and the computer programs for file maintenance, provide a number of edit or self-checking features. The guide was designed to facilitate keypunching. In addition, 100 percent of the coded data was key verified to ensure against keypunching errors.

2.12 DATA COMPILATION SYSTEM

A series of six computer programs was developed for compiling, analyzing, compressing, and presenting the data. In particular, a data retrieval system was provided which will allow for various types of questions to be asked of the data base. For example, one-way, two-way, and three-way tables, which combine the answers to specific combinations of questions, can be provided and printed out in a useful format. In addition, questions can be asked of the data base with provisions for AND, OR, and NOT operators. This provides for answering such questions as "How many interviewees answered YES to question 15 (the task was assigned) and A (received with task assignment) to question 40?"

Thus, it is possible to look at the interrelationships among the answers to various questions by each individual interviewee as well as the relationship of the total distribution

of a given question to the total distribution of another question. Since the programs also provide for a printout of the specific interview guide numbers, which satisfy a particular intersection, union, or negation inquiry, it is also possible to go back into the completed interview guides for further analyses.

2.13 ANALYSIS OF DATA

The data was compiled in three increments, upon completion of 474, 930, and 1,375 interviews. The computer data compilation system summarized, sorted, and formatted the data. Various presentations of the data were printed out in the form of simple frequency distributions with associated percentages, two and three-way tables, and the answers to specified intersection questions which showed the inter-relationship between the answers to several questions.

The data resulting from each survey question was evaluated in terms of its reliability and freedom from bias. Such factors as how easily the intent of the question could be communicated to the interviewee, whether the answer categories proved to be mutually exclusive and all inclusive, and the subjectivity of the question, entered into the evaluation. A rating scheme was developed using a simple index of 1 - 4 to indicate the quality of the data obtained by each question. A rating of 1 indicated excellent quality, whereas a rating of 4 indicated data having very marginal reliability. If the data from a particular question was considered to be of marginal reliability, little further analysis was performed on this question.

The procedure by which the various two-way and three-way tables and intersection inquiries were selected was as follows: first, the questions were grouped into four categories — environment (characteristics of the person and the task), responses (characteristics of the information required by the task), performance (characteristics of the information actually obtained for the task, i.e., timeliness, depth, source, volume, etc.), and narrative questions.

Next, the possibility of the existence of a significant relationship between the subjects of questions within one category and the subjects of questions within a second category was examined. Possible relationships between the subjects of two or more questions within a category were also examined. The hypotheses, underlying the possible existence of significant relationships, were developed jointly by DOD and AUERBACH.

On the basis of the possible relationships hypothesized, approximately 600 two-way and three-way tables were compiled and printed out by the computer system. Where appropriate, they were subjected to standard chi-squared tests at the 95 percent confidence level to determine whether or not there is a statistically significant relationship between the subjects of two questions. Where a significant relationship was found, an attempt was made to interpret and measure the degree of relationship.

A more detailed description of the analysis procedure is provided in Appendix A. Section III presents some of the results of the analysis. A selection of the more significant two-way and three-way tables with brief interpretive comments is presented in Section VI of Volume II.

SECTION III. ANALYSIS OF DATA

3.1 INTRODUCTION

The survey produced data in each of the following categories of the Interview Guide:

(1) Characteristics of the DOD RDT&E Population; e.g., age, education, job title, rating, MOS or job code, type, kind, and field of activity.

(2) Characteristics of RDT&E Tasks; e.g., field, length of task, how originated, kind, form, and nature of output.

(3) Characteristics of the Information Chunks Acquired and Used in Performing RDT&E Tasks; e.g., class, media, volume, depth, timeliness.

(4) Use of Information Services; e.g., TAB, DDC, information centers.

The RDT&E population was found to be quite heterogeneous in that it is engaged in a wide variety of tasks of varying scope throughout a broad range of fields. The findings described in Section I thereby relate to a typical randomly selected DOD technical man and the typical tasks in which he was found to be engaged. Consequently, it is important to examine whether the findings are uniform throughout all segments of the population, or whether a significant variation exists for a given type of person or task. For example, do people engaged in research tasks require performance and characteristics data as frequently as people engaged in development work?

The analysis methods described in Paragraphs 2.13 and A.5.3 of Appendix A were utilized to identify the existence or absence of significant variations in the findings. These variations are described in this Section. First, the characteristics of the population (e.g., field, education, type, and kind of activity) are compared against each other, against task characteristics, and with the use of information services. Second, the characteristics of the information chunks (e.g., class, media, depth, timeliness, volume) used in performing RDT&E tasks are compared to one another, and are then compared to various characteristics of the tasks (e.g., field, kind, form, and nature of output).

The findings presented in Section I were essentially based on the one-way distributions of the answers to individual questions. All of the one-way distributions for each of the survey questions, both pooled and unpooled, are presented without comment in Section VI of Volume II. Appendix B of this volume contains a discussion of each survey question and its associated one-way table. The reader is encouraged to refer to Appendix B for an explanation of the intent of each question, the statistical results, and a discussion of any problems which may have affected the quality of the data.

To make the comparisons presented in this Section, it was necessary to analyze not only the simple one-way distributions of the answers to the survey question, but also two-way and three-way distributions which combine the answers to two or three questions.

Approximately 600 tables were analyzed to determine possible relationships between the subjects of the various survey questions. A small sampling of these tables is included in this Section for ease of presentation. In several of these tables, the data in particular cells has been circled to highlight that portion of the table which is of primary interest to the pattern identified. Frequently, the only significance of a particular table is that there is no outstanding pattern or relationship between the subjects of the two questions being examined. In most cases, the reader is referred to Section VI which contains all of the one-way tables, and a selection of the most significant two-way and three-way tables including brief annotations describing their significance.

Figure 3-1 is an example of a two-way table with an explanation of how to read and interpret the row and column figures. The table number (0950), which appears at the upper left hand corner of the table, refers to the answers to Question 9 (Type of Activity) distributed against the answers to Question 50 (Do You Use DDC?). Looking at this sample table in Figure 3-1, we can examine it in several ways. First, we can compare the individual cell percentages against the column total percentage. For example, while 47 percent of the total population use DDC, only 35 percent of the people engaged in technical administration use DDC. Comparing the cell percentages against the row totals, we see that 57 percent of the total population are engaged in detailed scientific or engineering activities, and that 58 percent of those people who use DDC are in detailed scientific or engineering activities.

0950 -(7)-(2)- TYPE OF ACTIVITY VS. USE OF DDC

Question 50 Do you use DDC (ASTIA)?

Question 9 TYPE OF ACTIVITY	9-50	Yes A	No B	BLNK	RD DF	TOTAL
Detailed Scientific or Engineering	A	(47) (2) 373 (1) 58 (3)	53 413 57			(100) (5) (786) (4) (57) (6)
Technical Evaluation	B	52 206 32	48 192 26	2 17		100 399 29
Technical Administration	C	35 55 9	63 100 14	3 50		100 158 11
Other	D	19 6 1	75 24 3	6 2 33		100 32 2
RD DF						1
TOTAL		47 640 100	53 729 100	6 100		100 1375 100

EXPLANATION OF THE CALL OUTS

The three entries in each cell are as follows (refer to cell 9A-50A):

(1) 373 is the cell frequency; i.e., out of 1375 responses, 373 were in category A in question 9 and also in category A in question 50.

(2) 47 indicates that this cell contains 47 percent of all the entries for that row -- (373/786 x 100 = 47)

(3) 58 indicates that this cell contains 58 percent of all the entries for that column (373/640 x 100 = 58).

Similarly for row totals (refer to row 9A).

(4) 786 is the sum of the cells in that row (373 + 413 = 786).

(5) 100 is the sum of the cell row-based percentages including round-off error which appears in the column (or row) marked RD DF

(6) This number indicates that 57 percent of the population (786/1375 x 100 = 57) answered question 9 in category A-(Detailed Scientific or Engineering)

For Value of Questions (see upper left-hand corner) -

(7) Next to the question number is a one digit number set off by dashes (e.g., - 2 -). This number represents the composite evaluation which has been placed upon the reliability of the data contained in each table. A rating of - 1 - indicates that the quality of the data is excellent, whereas a rating of - 4 - indicates that the data has very marginal reliability.

Figure 3-1. Example of A Two-Way Table

3.2 CHARACTERISTICS OF THE DOD RDT&E POPULATION

Questions 1 - 11 are concerned with various characteristics of RDT&E personnel, including MIL/GS rating, Highest Degree and Field, MOS or Job Code, and Type, Kind and Field of Activity. The reader is referred to Appendix B for a discussion of the one-way distributions of the responses to these questions.

Personnel Characteristics vs. Task Characteristics

- Table 0112 (MIL/GS Rating vs. Field of Task) shows that there are no relationships between the fields of the tasks and the ratings of DOD RDT&E personnel, with one exception; there appear to be relatively more higher rated people performing tasks in the Aircraft and Flight Equipment field than in other fields.

- Table 0111 (MIL/GS Rating vs. Kind of Task) shows that higher rated people appear to be performing relatively more tasks in R&D support than in other kinds of tasks. Somewhat surprisingly, the table does not show that research tasks are normally performed by people with higher than average ratings. Table 0414 (Highest Degree vs. Kind of Task) shows that people with engineering degrees were heavily engaged in engineering development and reliability tasks, whereas people with scientific degrees tended to be engaged relatively more often in research tasks. This result is probably accounted for by the fact that research tasks tend to be of relatively longer duration than other tasks.

- Table 0912 (Type of Activity vs. Field of Task) shows that in the field of Aircraft and Flight Equipment, relatively more people were engaged in technical administration and fewer in detailed scientific and engineering work, as compared to other fields.

- Table 0914 (Type of Activity vs. Kind of Task) shows that research tasks required primarily detailed scientific and engineering people and proportionately less technical evaluation or administrative type people than did other kinds of tasks.

- Table 1012 (Kind of Activity vs. Field of Task) shows that research people were doing relatively fewer tasks in the fields of Aircraft and Flight Equipment and more in the fields of Medicine and Physics, Fluid Mechanics, and Nuclear Physics. Conversely, engineering people were found to be performing relatively fewer tasks in the fields of Aircraft and Flight Equipment, Guided Missiles, and Medicine and more in the field of Research and Research Equipment.

- Table 1014 (Kind of Activity vs. Kind of Task) shows a very heavy diagonal as would be expected, since the definitions of the categories are the same for Question 10 (Kind of Activity) as they are for Question 14 (Kind of Task). This pattern implies that people normally engaged in a particular kind of activity were found to be engaged in the same kind of task.

- Table 1112 (Field of Activity vs. Field of Task) also shows a heavy diagonal line which implies that the respondents' fields of endeavor tend to be the same as the fields of the tasks in which they are engaged.

Personnel Characteristics vs. Information Found After Task Completion

- Table 0148 (MIL/GS Rating vs. Post Task Information) shows that there is no relationship between a person's rating and whether or not he has found some pertinent but previously unknown information after the completion of the same task.

- Table 1048 (Kind of Activity vs. Post Task Information), Figure 3-2, and Table 1148 (Field of Activity vs. Post Task Information), however, show that research people tend to find relevant information after task completion more often than other types of personnel. This is true also for personnel engaged in mathematical work. People engaged in the field of Ordnance rarely found relevant information after task completion.

MIL/GS Rating vs. Type of Activity

- Table 0109 (MIL/GS Rating vs. Type of Activity) shows that people engaged in detailed scientific and engineering effort tend to have lower job ratings than people in technical evaluation and in technical administration.

Personnel Characteristics vs. Use of Information Centers

- Table 1149 (Field of Activity vs. Use of TAB) shows that people engaged in the fields of Aircraft and Flight Equipment, and Materials and Metallurgy used TAB relatively more than people in other fields. On the other hand, Table 1150 (Field of Activity vs. Use of DDC) shows that people engaged in the fields of Fuels and Propulsion Systems, and in the fields of Physics, Fluid Mechanics, Nuclear Physics, use DDC relatively more than people engaged in other fields. People working in the field of Medicine appear to use DDC relatively less than individuals in other fields.

1048 - 2 - KIND OF ACTIVITY vs. POST TASK INFORMATION

This comparison shows that, proportionally, research people seem to find more information after the completion of the task than do people in other activities.

	10-48	A: Information Found After Task Was Completed	B: No Information Found After Task Was Completed	BLNK	RD OF	TOTAL
Research	A	(17)	81	1	1	100
		36	171	3		210
		21	15	6		15
Exploratory, Advanced, Engineering, Operational Development	B	(14)	82	3	1	100
		97	553	21		671
		56	48	39		49
Reliability - Quality Control	C	(6)	94			100
		3	44			47
		2	4			3
R&D Support	D	(9)	85	6		100
		29	271	18		318
		17	24	33		23
Other, Blank	E	6	84	9	1	100
		8	109	12		129
		5	9	22		9
	RD OF	- 1				1
	TOTAL	(13)	83	4		100
		173	1148	54		1375
		100	100	100		100

Figure 3-2. Kind of Activity Vs. Post Task Information

- Table 0150 (MIL/GS Rating vs. Use of DDC) shown in Figure 3-3, presents a slight pattern which suggests that a person's use of DDC increases with his rating. Technical evaluation people were found to use DDC relatively more than detailed scientific and engineering people or administrative people (see Figure 3-1).

- Table 0152 (MIL/GS Rating vs. Use of Information Centers) shows a slight pattern which indicates that as a person's rating increases so does his use of specialized information centers. This pattern is somewhat more pronounced than the corresponding finding in the previous paragraph derived from Table 0150.

- People classified as Technical Evaluation were found to use information centers relatively more than people classified as Detailed Scientific and Engineering or classified as Technical Administration. This comes from a comparison of the circled figures on Table 0952 (Type of Activity vs. Use of Information Centers) shown in Figure 3-4. Table 1152 (Field of Activity vs. Use of Information Centers) shows no outstanding patterns, which implies that a person's field of activity is independent of his use of information centers.

Personnel Characteristics vs. Information Problem

An examination of Tables 0156, 0756 (Figure 3-5) and 1156 (MIL/GS Rating, MOS or Job Code, Field of Activity vs. Presence of Information Problem) shows that as the three personnel characteristics (rating, MOS, and field) vary, no significant relationships are found between personnel characteristics and the presence or absence of an information problem. Table 0456 shown in Figure 3-6, however, displays a pattern which implies that people with post-graduate degrees tend to express having a serious problem in finding or obtaining information relatively more than those with a bachelor's degree or those with no degree.

3.3 CLASS OF INFORMATION CHUNK

Question 25 (Class of Information) demonstrated the widespread use of performance and characteristics and specifications data in all varieties of RDT&E tasks. It was found that of the total number of chunks of information required in the sampled tasks, 42 percent were classified as performance and characteristics and specifications

Using the chi squared test with the null hypothesis that a person's rating is independent of his use of DDC, it was found that at the five percent confidence level the hypothesis should be rejected. The table shows that higher rated people tend to use DDC and lower rated people do not.

		Uses DDC		Does Not Use DDC		
	1-50	A	B	BLNK	RD DF	TOTAL
GS05, GS07, 00E2, 00E5 00E6, Blank	A	(19)	81			100
		10	43			53
		2	6			4
0001, GS09	B	(32)	68			100
		36	75			111
		6	10			8
0002, GS11	C	(35)	65			100
		73	137			210
		11	19			15
0003, GS12	D	(47)	53			100
		147	165	1		313
		23	23	17		23
0004, GS13	E	(56)	43		1	100
		184	141	1		326
		29	19	17		24
0005, GS14	F	(52)	46	2		100
		116	103	4		223
		18	14	67		16
0006, GS15	G	(51)	49			100
		58	55			113
		9	8			8
0007, 0008, GS16 0313	H	(62)	38			100
		16	10			26
		3	1	.		2
	RD DF	- 1		- 1		
	TOTAL	(47)	53			100
		640	729	6		1375
		100	100	100		100

Figure 3-3. MIL/GS Rating Vs. Use of DDC

This table shows a slight tendency for technical evaluation people to use information centers relative to the rest of the population.

9-52		Uses Information Centers A	Does Not Use Information Centers B	BLNK	RD DF	TOTAL
Detailed Scientific or Engineering	A	(53)	46	2	- 1	100
		414	359	13		786
		55	59	62		57
Technical Evaluation	B	(62)	38	1	- 1	100
		246	151	2		399
		33	25	10		29
Technical Administration	C	(51)	47	2		100
		81	74	3		158
		11	12	14		11
Other	D	28	63	9		100
		9	20	3		37
		1	3	4		2
	RD DF		1			1
	TOTAL	(55)	44	2	- 1	100
		750	604	21		1375
		100	100	100		100

Figure 3-4. Type of Activity Vs. Use of Information Centers

This table shows no outstanding features other than that people engaged in the mathematics-statistics series seem to have relatively less of an information problem than those people in other job codes.

		Has Information Problem		Has No Information Problem		
7-56	A	B	BLNK	RD OF	TOTAL
Biology, Medical Officer →	A	33	58	8	1	100
		16	28	4		48
		4	3	5		3
General Engineering; Civil, Electronic, Aerospace, Marine, Industrial, and Mechanical Engineering →	B	28	67	6	- 1	100
		192	466	39		697
		52	51	46		51
General Physical Sciences; Physics, Chemistry, Metallurgy and Meteorology →	C	29	65	6		100
		87	197	17		301
		24	21	20		22
Mathematics →	D	(10)	87	4	- 1	100
		8	71	3		82
Unknown Geography, Psychology, Library and Archives, R&O Coordination, and Navigator and Photographer →		2	8	4		6
	F	27	64	9		100
		67	159	21		247
		18	17	25		18
RD OF						
TOTAL		(27)	67	6		100
		370	921	84		1375
		100	100	100		100

Figure 3-5. MOS or Job Code Vs. Presence of Information Problem

0456 - 2 - HIGHEST DEGREE AND FIELD vs. PRESENCE OF INFORMATION PROBLEM

Proportionally more people with higher degrees consider that they have an information problem.

		Has Information Problem	Has No Information Problem			
4-56		A	B	BLNK	RC DF	TOTAL
No Degree	A	23	70	7		100
		32	96	9		137
		9	10	11		10
Bachelor in Aero, Chemical, Civil, Electrical, Industrial, Mech, Metallurgy, General, Other, Engineering	B	26	68	7	- 1	100
		136	358	35		529
		37	39	42		38
Bachelor in Agriculture, Biology. Chemistry, Math, Physics, Psychology	C	26	70	4		100
		94	259	15		368
		25	28	18		27
Master in (all those in B)	D	(36)	58	7	- 1	100
		33	53	6		92
		9	6	7		7
Master in (all those in C)	E	(32)	61	7		100
		43	81	9		133
		12	9	11		10
Ph.D in (all those in B)	F	(50)	38	13	- 1	100
		4	3	1		8
		1		1		1
Ph.D in (all those in C)	C	(25)	67	9	- 1	100
		23	62	8		93
		6	7	10		7
All Medicine	K	(33)	60	7		100
		5	9	1		15
		1	1	1		1
RD DF				- 1		- 1
TOTAL		(27)	67	6		100
		370	921	84		1375
		100	100	100		100

Figure 3-6. Highest Degree and Field Vs, Presence of Information Problem

Class of Information vs. Task Characteristics

Figure 3-7 compares the answers to Question 25 (Class of Information) to the answers to Questions 12 (Field of Task), 14 (Kind of Task), 17 (Length of Task), and 94 (Task Output).

- Within Figure 3-7, the comparison of Field of Task vs. Class of Information shows that there is no significant difference in the degree of use of one class of information over another as the field of the task changes.

- The comparison between Kind of Task and Class of Information shows that Research tasks tend to require relatively more concept information and less performance and characteristics information than do the other kinds of tasks.

- Engineering tasks were found to require more Performance and Characteristics and Specifications data than other kinds of tasks.

- A comparison between the Man-Days of the Task and Class of Information shows that as the length of a task increases, there appears to be a greater use of concept information.

- A comparison between the Task Output and the Class of Information confirms that there is a fairly strong correspondence between the nature of the output of the task and the class of information used within the task.

In summary, it can be said that with minor exceptions, as the task characteristics change, there does not appear to be a significant change in the classes of information used to conclude the tasks. It is further observed that the high usage of performance and characteristic and specifications data, and "how-to-do-it" information (design techniques, etc.) does not appear to vary significantly with differences in RDT&E task characteristics.

Class of Information vs. Media

The media used to convey information are described in Question 28 which is discussed in Appendix B. The most popular means of obtaining information was by way of oral media, a distant second being by way of proposals and reports. When Question 25 (Class of Information) was compared to Question 28 (Media), the following patterns were found to exist (see Table 2528 in Figure 3-8).

(1) Concept information was conveyed principally by way of texts, journals, and from previous knowledge; relatively little use was made of brochures, catalogs, standards, drawings, parts lists, etc. (category A of Question 28).

(2) Cost and funding information seemed to be conveyed relatively more often by way of the oral media rather than by any other media.

(3) "How-to-do-it" information (design techniques, etc.) did not tend to be communicated by any one particular medium.

(4) Math aids and formulae seemed to be obtained principally from texts.

(5) Performance and characteristics, and specification information was obtained to a great extent from brochures, catalogs, standards, etc. (category A of Question 28), whereas very little performance and characteristics, and specifications information was obtained from texts.

Class vs. Volume of Information

Table 2532 (Class of Chunk vs. Actual Exposure to Information) shows the exposure to an assumed quantity (volume) of information obtained in the sampled tasks for each class of information. By examining this table, it is found that for math aids and formulae, one item containing the information is usually sufficient in most cases. Generally, however, this table shows no outstanding patterns, implying that the exposure to information does not vary significantly as the classes of information change. A comparison between Tables 2532 and 2533 (Class of Chunk vs. Desired Exposure to Information) shows the difference between the exposure wanted and the exposure actually obtained. It is interesting to note that there is relatively no difference between these two tables, possible implying that the user either gets what he wants or accepts whatever he gets (i.e., he has learned to live with the system).

Class vs. Depth

Table 2538 (Class of Chunk vs. Actual Depth of Information) shows the relationship between the depth of the information actually obtained and the class of information. By examining this table, it is seen that math aids and formulae, and raw data are commonly received in the form of a specific answer (great depth) whereas technical status information is more commonly received in a once-over lightly treatment (limited depth).

Note:

- All figures are percentages.
- Information that was recorded during interview as "Other" or "Blank" is not included in these tables; therefore, the columns may not add up to 100%.
- All data is pooled where appropriate.

Classes of Information (Question 25)	One-Way Distribution of Classes of Information (Pooled)	Field of Task (Question 12)												
		Aircraft & Flight Equipment	Astronomy, Geography	Chemical Warfare Equipment, Chemistry	Electronics, Communications	Detection	Fuels & Propulsion	Transportation	Guided Missiles	Materials, Metallurgy	Mathematics	Medical Sciences	Ordnance	Physics, Fluid Mechanics
		01	02	03	05	06	10	11	12	14	15	16	22	25
A. Concept	8	6	12	13	7	6	3	10	9	6	11	8	5	14
B. Cost and Funding	3	5	3	2	3	4	2	6	4	5	0	1	2	2
C. Design Techniques, Experimental Processes, Production Processes, Test Processes, Utilization	20	14	14	23	25	12	28	26	11	27	14	24	21	23
E. Math Aids and Formulae	6	5	12	6	5	2	2	0	7	4	26	3	7	7
F. Performance and Characteristics Specifications	42	49	35	33	42	49	46	39	50	40	20		45	29
H. Raw Data	5	3	8	7	3	7	3	0	6	7	14	3	5	8
J. Technical Status	11	13	15	14	12	14	10	10	7	9	11	16	9	13

TASK CHARACTERISTICS																													
									Kind of Task (Question 14)				Man-Days of Task (Question 17)				Task Output (Question 94)												
Ordnance	Physics, Fluid Mechanics	Medical Sciences	Ordnance	Physics, Fluid Mechanics	Management & Production	Research & Research Equipment	Ships & Marine Equipment	Miscellaneous Engineering	Research	Engineering	Reliability – Quality Control	R&D Support	1 to 5 Days	6 to 22 Days	23 to 132 Days	Over 132 Days	Concept	Cost & Funding, Administrative Action	Designs	Experimental Processes	Mathematical Aid; Computer Programs	Performance & Characteristics	Production Processes	Raw Data	Specifications	Technical Status	Test Processes	Utilization	Evaluation
22	25	16	22	25	26	30	31	34	A	B	F	G	005	022	132	999	A	B	C	D	E	F	G	H	I	J	K	L	M
5	14	8	5	14	8	9	7	9	13	8	6	6	7	8	11	17	20	5	7	11	10	10	7	10	6	7	4	1	7
2	2	1	2	2	5	4	4	4	1	3	1	3	4	3	1	2	1	12	1	0	0	2	2	0	5	6	1	0	3
21	23	24	21	23	19	19	23	16	22	19	34	21	19	20	21	19	19	15	21	22	21	20	37	26	17	13	30	36	18
7	7	3	7	7	3	6	3	7	8	5	8	7	5	5	8	8	9	1	6	7	19	8	0	5	1	2	2	1	4
45	29	39	45	29	41	42	45	45	29	45	40	43	44	40	39	36	23	40	50	33	28	43	42	40	53	39	46	47	40
5	8	3	5	8	1	4	7	2	7	4	4	4	4	5	6	2	6	2	2	5	10	6	3	4	4	6	3	4	5
9	13	16	9	13	17	10	8	9	14	10	4	11	11	12	8	10	19	14	9	21	8	7	8	3	10	21	8	6	14

Figure 3-7. Relationships Between Classes of Information and Characteristics of Tasks

This table shows the following highlights: concept infor
engineering type media. Cost and funding information i
in texts, manuals, and handbooks. Performance and sp
(engineering media), the oral mode, and in proposals a
obtained by way of proposals and reports, the oral mod

	Brochures, Catalogs, Standards and Codes, Drawings, Schematics, Parts Lists, System Specs (QMR, TDP...)	Oral, Meetings and Symposia	Live Demonstration, Physical Measurement or Experiment	Directives, Handbooks, Manuals	Corr Mem Pers Files
25-28	A	B	C	D	
Concepts	A 3 19 2	23 148 7	1 7 3	5 32 6	4 2
Cost and Funding	B 9 19 2	41 87 4		4 8 1	17 3
Design Techniques, Experimental Processes, Production Processes, Utilization, Test Processes	C 11 162 19	31 481 21	4 54 21	9 145 25	7 11
Math Aids and Formulae	E 4 14 2	17 63 3	1 3 1	16 62 11	4 1
Performance and Characteristics, Specifications	F 16 536 61	29 953 42	4 135 52	8 264 46	9 28
Raw Data	H 7 23 3	22 73 3	9 31 12	4 12 2	16
Technical Status	J 5 49 6	31 308 14	2 17 7	2 24 4	6
Other	N 12 50 6	38 163 7	3 13 5	8 32 6	11
RD DF	- 1	- 1	- 1	- 1	
TOTAL	11 872 100	29 2276 100	3 260 100	7 579 100	8 6

MEDIA

concept information is found proportionally more in texts and journals and less in information is obtained by the oral media. Math and formula information is found rmance and specification information, to a great extent, comes from a category in proposals and reports, and is not found in texts. Status information is principally , the oral mode, and journals.

	Directives, Handbooks, Manuals	Correspondence, Memos, TWX Personal Notes, Files and Logs	Newsletters Mass Media	Preprint, Reprint, Journal	Reports Proposals	Texts	Photographs Maps Films	Previous Knowledge	Computer Printout	Other	RD DF	TOTAL
	D	K	N	P	R	S	T	V	W	Z	RD DF	TOTAL
		4		9	12	19	1	21			2	100
	32	27	1	59	78	120	4	136	3	2		636
	6	4	3	16	6	27	7	16	4	4		8
		17			16			8	1	3	1	100
	8	37		1	35			17	2	7		213
	1	6			3			2	2	15		3
		7		5	14	4	1	13		1		100
	145	111	5	75	209	68	8	207	5	10		1540
	25	18	14	20	16	15	13	25	6	22		20
		4	1	5	11	26		13	2			100
	62	15	4	18	41	98		50	9	1		378
	11	2	11	5	3	22		6	11	2		5
		9		3	18	3	1	8	1			100
	264	286	16	98	576	91	27	264	25	12		3283
	46	45	43	26	45	20	45	32	30	26		42
	4	16		3	20	2	4	2	9	1	1	100
	12	51	1	9	65	6	14	7	31	3		328
	2	8	3	2	5	2	23	1	38	7		4
	2	6	1	11	23	6	1	12		1	- 1	100
	24	61	9	104	225	56	5	119	3	6		986
	4	10	24	27	17	13	8	14	4	13		13
	8	11		4	14	1		7	1	1		100
	32	46	1	15	60	6	2	30	4	5		426
	6	7	3	4	5	1	3	4	5	11		5
	- 1		- 1				1					
	7	8		5	17	6	1	11	1	1		100
	579	634	37	379	1289	446	60	830	82	46		7790
	100	100	100	100	100	100	100	100	100	100		100

Figure 3-8. Class of Chunk Vs. Media

Any significance attached to the patterns of information in this table, however, must be qualified by the low reliability value (3) of the data produced by Question 38.

Class vs. Field of Task vs. Field of Chunk

The three-way Table 251226 (Class of Chunk vs. Field of Task vs. Field of Chunk) shows a high degree of correspondence between the field of the task and the field of the classes of information used within the same tasks. This is evident by the pronounced diagonal throughout each of the sub-tables, which shows the interdisciplinary aspects of information. The degree of this relationship, however, was found to vary somewhat with different classes of information. For example, tasks in a given field tend to use cost and funding information almost exclusively in the same field as the tasks. However, tasks using "how-to-do-it" information (design techniques, experimental production and test processes, utilization) were found to use a fair amount of "how-to-do-it" information in fields other than the field of the task. The same pattern was also observed for tasks using a high percentage of performance and characteristics, and specifications information; i.e., a considerable amount of performance and characteristics and specifications information was used in fields other than the field of the task.

3.4 FIRST SOURCE OF TASK-REQUIRED INFORMATION

The results of Question 42 (first source) demonstrated the significance of the local environment (or informal information system) and the infrequent reliance on libraries and information centers as a first source of information. The one-way table for Question 42 is reproduced below. An explanation of the frequency column and the blank category for this and other one-way tables is found in the introduction to Appendix B.

Question 42

What was the first organization or person you went to in order to obtain this information?

		Frequency	Percent
A.	Received with Task Assignment	496	11
B.	Supervisor (if Given by Supervisor after Assignment), Assignment to Subordinate	268	6
E.	Consultants, Colleague	1027	22
F.	Librarian or Technical Researcher, Library (Search by Self)	243	5

		Frequency	Percent
H.	Department Bookcase or Files	608	13
I.	Own Collection	820	17
J.	Information or Data Centers	19	0
K.	Manufacturer or Supplier	215	5
L.	Blank	991	21
	Total	4687	

First Source vs. Task Characteristics

The first source to which the respondent went to acquire task-required information was examined in relation to the characteristics of the tasks.

- Table 1242 (Field of Task vs. First Source) shows that there is no significant pattern between the field of a task and the use of any particular first source, with the one exception that for Aircraft and Flight Equipment tasks, manufacturers were used as a first source more often than in other fields.

- Table 1442 (Kind of Task vs. First Source) in Figure 3-9 further shows that as tasks are classified in another manner, there is still no cutstanding relationship to a particular first source, with one exception; libraries were used as a first source of information for research tasks relatively more often than for any other category of tasks.

- Table 1742 (Man-Days of Task vs. First Source) shown in Figure 3-10 compares the level of effort in a task against the use of the various first sources, which again tends to confirm that the use of a particular first source is not dependent on task characteristics.

First Source vs. Class

When classes of information (Question 25) are compared to the use of the various first sources (Table 2542), it is found that there are no outstanding patterns between the use of any particular first source and the various classes of information. Two minor features, however, do stand out: first, libraries seem to be used relatively more as a first source of concept and technical status information; and second, a person's own collection seems to be used relatively more as the first source for math aids and formulae than other first sources.

1442 - 1 - KIND OF TASK vs. FIRST SOURCE

This table shows that people doing research tasks use the library proportionally more and manufacturers proportionally less as a first source of information.

14-42		Received with Task Assignment A	Supervisor or Subordinate B	Consultant Colleague E	Librarian Researcher, Library F	Department Bookcase or Files H	Own Collection I	Manufacturer, Information Centers K	Blank L	RD DF	TOTAL
Research	A	8	4	17	14	11	24	2	20		100
		45	21	99	79	66	141	14	117		582
		9	8	10	(33)	11	17	(6)	12		(12)
Exploratory, Advanced Engineering, Operational Development	B	11	6	22	5	15	15	7	20	- 1	100
		259	142	533	113	350	361	157	489		2404
		52	53	52	47	58	44	67	49		51
Reliability - Quality Control	C	9	6	25	1	12	17	6	24		100
		20	14	55	3	27	37	13	52		221
		4	5	5	1	4	5	6	5		5
R&D Support	D	12	6	23	3	12	19	3	22		100
		154	76	289	42	147	236	40	275		1259
		31	28	28	17	24	29	17	28		27
Other, Blank	E	8	7	23	3	8	20	5	26		100
		18	15	51	6	18	45	10	58		221
		4	6	5	2	3	5	4	6		5
RD DF											
TOTAL		11	6	22	5	13	17	5	21		100
		496	268	1027	243	608	820	234	991		4687
		100	100	100	100	100	100	100	100		100

Figure 3-9. Kind of Task Vs. First Source

1712 - 1 - MAN-DAYS OF TASK vs. FIRST SOURCE

The data in this table shows the time to perform a task has little or no effect on the choice of the first sources of information.

17-42		Received with Task Assignment A	Supervisor or Subordinate B	Consultant Colleague E	Librarian Researcher, Library F	Department Bookcase or Files H	Own Collection I	Manufacturer, Information Centers K	Blank L	RD DF	TOTAL
1 to 5 Days	005	11	5	20	3	14	18	4	25		100
		252	126	464	72	319	424	103	593		2353
		51	47	45	30	52	52	44	60		50
6 to 22 Days	022	11	7	24	6	12	16	5	19		100
		162	104	363	87	174	238	78	286		1492
		33	39	35	36	29	29	33	29		32
23 to 132 Days	132	10	4	25	9	15	18	7	13	- 1	100
		69	32	176	65	107	128	49	92		717
		14	12	17	27	18	16	21	9		15
Over 132 Days	999	10	5	19	15	6	24	4	16	1	100
		13	6	24	19	8	30	5	20		125
		3	2	2	8	1	4	2	2		3
	RD DF	- 1		1	- 1		- 1				
	TOTAL	11	6	22	5	13	17	5	21		100
		496	268	1027	243	608	820	234	991		4687
		100	100	100	100	100	100	100	100		100

Figure 3-10. Man-Days of Task Vs. First Source

Performance of the First Source

Question 45 determined what was obtained from the first source, e.g., all of the information, part of the information, a reference to further information, or nothing. In 39 percent of the cases, the first source provided all of the information required.

- Table 4245 (First Source vs. Information Obtained from First Source) shows that where the First Source was a colleague, a supervisor, or a subordinate, the information obtained was frequently a reference to further information, rather than all or part of the information required.

3.5 VOLUME OF INFORMATION (Exposure)

In the great majority of cases, the user does not want to be exposed to all of the relevant information which is available. The user is generally satisfied either with a single item of material or a sampling of the available material. The one-way table for Question 33 is presented below.

Question 33

Concerning the total amount of material available, which potentially contains information on this chunk, how much of it did you want to be exposed to?

		Frequency	Percent
A.	One Item of Material	1611	34
B.	A Sampling of the Available Materials	1240	26
C.	All Available Material	1050	22
D.	Blank	784	17
	Total	4687	

The 17 percent under "Blank" is composed almost entirely of those information chunks which the respondents recalled from their own previous experience.

Volume vs. Kind of Task

Table 1433 (u) (Kind of Task vs. Exposure to Information Wanted-Unpooled) presents no outstanding pattern between the kind of tasks and the volume of information wanted for the chunks of information used in concluding these tasks.

Volume vs. Search Aids

It might be assumed that people who want to be exposed to a large quantity of information would at the same time want to use some type of search aid to help them in selecting the most appropriate items to examine in detail. Table 3334 (Desired Exposure to Information vs. Use of Search Aids) did not present any significant patterns. The relatively large numbers found in row C of this table are due to the fact that Question 34 (Search Aids) was asked only of those who indicated a need for a large volume of information.

Volume vs. Depth

Table 3339 (Desired Exposure to Information vs. Desired Depth of Information) shows that when people want to be exposed to one item of the available information, they generally appear to be searching for a specific answer. There are, however, no other significant patterns between the information exposure wanted and the desired depth of information.

3.6 SEARCH AIDS

Question 34 was designed to determine whether search aids were used or desired by those who needed a large quantity of information. The question was not asked of those who did not indicate a need for a large volume of information, since it was presumed that in this situation search aids would not have been required. This accounts for the large number of blanks (no answer) in the one-way distribution shown below. Of the 19 percent of the chunks of information for which affirmative answers were obtained (e.g., A, B, or F.), search aids would have been useful or were already being used in 68 percent of these cases.

Question 34

Since you wanted to see a lot of material, would you have found title listings or abstracts more useful to read first in order to help you select the chunk of material to read in detail?

		Frequency	Percent
A.	No, Wanted to review all the material Explain	263	6
B.	Title Listing, Abstracts, or both	466	10
F.	Already Used Either or both	155	3
X.	Blank	3803	81
	Total	4687	

Search Aids vs. Field of Task

From Table 1234 (Field of Task vs. Search Aids), it was found that search aids were not generally considered to be useful by those engaged in tasks in the field of Communications and Electronics. Conversely, search aids were more heavily used in tasks in the fields of Medicine, Physics, Fluid Mechanics, and Nuclear Physics.

3.7 DEPTH OF INFORMATION

Questions 38 and 39 are companion questions dealing with the depth of information received and wanted, respectively. Depth was defined as either a "Once-Over-Lightly" treatment of the subject or as a "Detailed Analysis." A third category "Specific Answer" was treated as a subcategory of "Detailed Analysis" (considerable depth). The significant finding was that the RDT&E population wanted either a Detailed Analysis or Specific Answer in the great majority of cases.

Question 38

Depth of Information Received. Did you get a:

		Frequency	Percent
A.	Once over lightly of the subject	859	18
B.	Detailed Analysis	1994	43
C.	Specific Answer	1002	21
D.	Nothing	42	1
Blnk.	Blank	790	17
	Total	4687	

Question 39

Depth of Information Wanted. Would you want a:

		Frequency	Percent
A.	Once over lightly of the subject	700	15
B.	Detailed Analysis	2152	46
C.	Specific Answer	1043	22
Blnk.	Blank	792	17
	Total	4687	

Varying task characteristics were compared to the depth of information desired for the required chunks of information. Tasks in the fields of Aircraft and Flight Equipment appear to require only a once-over-lightly treatment relatively more often than tasks in other fields. The respondents engaged in tasks in the field of Medicine were relatively less often satisfied with a once-over-lightly treatment.

- Tables 1439 (u) and 1739 (u) (Kind of Task vs. Desired Depth of Information) show no significant patterns. This implies that the depth of information wanted bears little relationship to task characteristics.

- From an examination of Table 3942 (u) (Desired Depth of Information vs. First Source) there further appears to be no relation between the use of any particular first source of information and the depth of the information wanted.

3.8 RETRIEVAL TIME

Questions 35 and 36 are concerned with how quickly the information was received and how quickly it was required. It was found that in only 18 percent of the cases was the required information needed in less than one day or received with the task assignment, while 41 percent of the information was actually obtained within one day(or received with the task assignment).

Question 35

From the time you requested this chunk or started to search for it, what was the actual time it took to get it?

		Frequency	Percent
A.	No, or Not Applicable	351	7
B.	Under 1 Day	1676	36
C.	Under 1 Week	735	16
D.	Under 1 Month; Under 3 Months; Over 3 Months	895	19
G.	Received with task assignment	228	5
X.	Blank	802	17
	Total	4687	

Question 36

From the time you requested this chunk or started to search for it, was there a maximum time you could have allowed to get it?

		Frequency	Percent
A.	No, or Not Applicable	738	16
B.	Under 1 Day	617	13
C.	Under 1 Week	998	21
D.	Under 1 Month; Under 3 Months; Over 3 Months	1315	28
G.	Received with task assignment	212	5
X.	Blank	807	17
	Total	4687	

Retrieval Time vs. Kind of Task

- Table 1436 (u) (Kind of Task vs. Desired Retrieval Time) shows that there are no significant patterns between the time information is wanted and the categories of tasks found in Question 14 with the one exception, that Research tasks rarely require information in less than one day.

- Table 1735 (Man-Days of Task vs. Actual Retrieval Time) also shows no significant patterns between the length of the task and the actual time to obtain information.

Retrieval Time vs. Volume

- Table 3336(u) (Desired Exposure to Information vs. Desired Retrieval Time) shows in Figure 3-11 that there are no significant patterns between the time information is wanted and the volume of information or degree of exposure wanted, with two minor exceptions: when information is wanted in under one day, there seems to be a tendency to examine only one specific item of the available material (see Row A, Column B, of Figure 3-11); when up to three months can be allowed, there appears to be a relatively greater desire to be exposed to all the information (see Row C, Column F of Figure 3-11).

Retrieval Time vs. First Source

- Table 3542 (Actual Retrieval Time vs. First Source) shows several patterns which exist between the use of the various first sources and the length of time required to retrieve information. When the information is retrieved in under one week,

colleagues, manufacturers, and suppliers are used relatively more as a first source of information. When it takes more than one week to obtain information, the library, manufacturer and supplier, and supervisor and subordinate are more frequently used as the first source.

This table shows no outstanding features.

One Item of the Available Material which Contains the Information / A Sampling of the Available Material / All the Available Material	No or Not Applicable A	Less than One Day B	Less than One Week C	Less than One Month D	Less than Three Months E	Over Three Months F	Received with Task Assignment G	BLNK	RD DF	TOTAL
A	19	22	25	18	5	3	9	1	- 2	100
	300	352	409	282	73	45	139	11		1611
	41	57	41	34	24	24	66	1		34
B	18	11	27	25	9	6	3	1		100
	221	140	337	307	116	71	35	13		1240
	30	23	34	37	39	38	17	2		26
C	20	12	24	23	10	7	3	1		100
	214	124	248	240	110	70	33	11		1050
	29	20	25	29	37	38	16	1		22
BLNK			1				1	98		100
	3	1	4		1		5	772		786
							2	96		17
RD DF							- 1			1
TOTAL	16	13	21	18	6	4	5	17		100
	738	617	998	829	300	186	212	807		4687
	100	100	100	100	100	100	100	100		100

Figure 3-11. Desired Exposure to Information Vs. Desired Retrieval Time

APPENDIX A. STUDY EXECUTION

This Appendix contains a detailed description of how the study was executed and is intended to supplement Section II, which presented a brief description of the Conduct of the Study. This Appendix also discusses the problems of the study, the methodology that was used to solve these problems, and the reasons for the decisions and assumptions that were made.

The first part of the Appendix contains a discussion of the overall study approach. This is followed by a discussion of the four major parts of the study, which are:

(1) Survey Techniques.

(2) Sampling Plan.

(3) Survey Execution.

(4) Compilation and Analysis.

A.1 STUDY APPROACH

Before considering the details of each phase, it is useful to consider some of the macroscopic problems of the task to obtain a proper perspective of the study since the magnitude and scope of this study exceeds that of any other user studies described in the literature. Other studies have generally been of more limited scope and have been confined to a specific discipline, e.g., a survey of 200 chemists. Also, most other studies have been concerned with probing the media used by the respondents, with the result that the nature of the information itself and its application have received less attention than the means by which it was conveyed. An annotated bibliography containing a description of many of these studies is in Appendix C of this volume.

A.1.1 Survey Design

The available population, exceeding 36,000 RDT&E personnel, dispersed over a large geographic area, posed a major problem. A sample size exceeding 1,200 interviews was required to gather information that was representative of the total population. It was therefore necessary to devise a system for gathering, processing, and analyzing the results of the interviews as efficiently as possible to work within a realistic study schedule. For this reason considerable attention was paid to the development of a workable interview guide. The design of the guide consisted of over 15 stages, involving iterative steps of design, test, analysis, and redesign.

A.1.2 Population

The heterogeneity of the population posed problems in formulating appropriate questions in the interview guide and ensuring that the answers would be comprehensive and unambiguous. The population contains a wide variety of scientific and engineering disciplines; members range from those doing detailed work in their discipline to those performing broad administrative and evaluative work, either in one discipline or a mixture of disciplines. It was decided that the best way to cope with these problems was to conduct an in-depth interview lasting approximately two hours. An interview guide would be used and it would contain ample space for entering appropriate narrative comments.

A.1.3 Pilot Testing

A series of test interviews was conducted for the purposes of testing the interview guide and interview techniques, and as an aid to interviewer training. The pilot testing was done in two stages; the pre-pilot stage, which consisted of 18 interviews with technical personnel from the AUERBACH Corporation and the Frankford Arsenal in Philadelphia; and the pilot stage, which consisted of 73 interviews at DOD installations in the Washington area. The Revisions to the interview guide and technique resulted in changing from a media-oriented guide to one concentrating on the characteristics of the information required for a task, and from an unstructured guide to a semi-structured guide. It should be stressed that the purpose of the pilot interviews was not to gather information, but rather to provide feedback for improving all aspects of the survey methodology.

A.1.4 Sampling

Another important consideration was the necessity to derive a representative sample of the population. The decision problem lay in the choice of a sampling technique, i.e., a stratified sampling or a simple random sampling technique. A stratified sample is one in which selections are made randomly from segmented groups of the population. While the stratified sample might have resulted in greater precision, the choice was made to use simple random sampling. The primary reason for this choice was that an insufficient amount of tested, a priori information was available about the population to ensure proper stratification. The random sample was checked by comparing the sample's geographic distribution against the population's geographic distribution, and it was found to be representative.

A.1.5 Identification of Information

Implicit in the design of the interview guide is the question of how to identify the information required by the user and how to analyze the data after it is collected. A significant feature of the study is the development and use of a method for explicitly identifying those pieces of information which were wanted and used by the respondent. The pieces of information used to answer a particular question are collectively called a "chunk". A chunk is the smallest identifiable unit of task-required information which would lose its identification and meaning with respect to the task, if segmented further. While the concept of a chunk of information does not provide a quantitative measure of information, its advantage is that it is a workable and understandable unit.

The choice of information "measurement," however, posed a problem since chunks are not independent of one another and since they are by definition dependent on the sampled tasks. It is therefore not possible to apply the standard statistical tests in analyzing the data derived from combinations of such questions. Nevertheless, it was considered that the definition and use of the "chunk" concept enabled a useful degree of objective analysis. Questions in the interview guide which do not involve information "chunks" are still amenable to standard tests, and such tests have been made.

A.1.6 Elimination of Bias

The design of the survey attempted to reduce and eliminate potential bias by creating the proper environment in which the interview was to be conducted. Such things as directed answers by superiors and concern on the part of the respondent that his superior might review his answers, were expected. To circumvent these problems, certain interviewing procedures were used:

(1) Guarantee of interviewee anonymity.

(2) No audience during interview.

(3) Interviewers would check and cross-check answers to eliminate bias and test for reasonable answers.

It was found early in the field interview stage that these problems did not exist to any extent. Most respondents had little or no feeling about remaining anonymous, and it was felt by the interviewers that virtually no directed answers were being obtained.

A.2 SURVEY TECHNIQUE

To implement the objectives of the study, an examination was made of the techniques available for collecting data. The following techniques were rejected:

(1) Mailed Questionnaire: This approach was considered not feasible because it would have produced non-standard, probably biased, data which would be difficult to interpret.

(2) Diary Technique: This technique would require selected personnel to record certain information in a diary at the end of a given period of time. The approach was rejected for essentially the same reasons as the mailed questionnaire.

(3) Direct Observation: This technique would involve assigning an observer to each respondent for a period of time. The purpose of the observer would be to observe and record the information the respondent acquired and used. The technique was rejected because it was impractical from a time and cost consideration.

The method eventually chosen was the critical incident technique based on a personal interview with each respondent. This method allows specific data to be obtained with a minimum of bias and within reasonable time and cost considerations.

A.2.1 Development of the Interview Guide

The final guide used in the mainstream of interviews evolved from a very loosely structured instrument of informally phrased questions and minimum framework to a semi-structured, more formally organized interview guide. At no time, however, did the guide become a rigid questionnaire of a "Yes-No" character, or of a limited range of responses. The interviewer always had the option of ignoring multiple choices or categorization if they did not fit the situation: the alternatives were narrative comments or outright omission of the questions.

(1) Evolution to semi-structured guide

The progression from a very loosely structured to a semi-structured guide was a natural one. The semi-structured version was possible only after the pertinent questions and most of their possible responses had been pinpointed by the loosely structured pre-pilot interviews.

(2) Discard Media-Oriented Guide

A second noticeable trend during the development of the guide was the shift away from cataloging the type and

quantity of media used by respondents. Early versions of the guide had, as their primary objective, the analysis of what journals, texts, or other type media were instrumental in shaping the respondent's information repertoire. Gradually, the study team began to realize that what they needed was a more concise description of the type of technical information used, not the name of the media from which it was obtained.

(3) Critical Incident Technique

A third development trend was the selection of the critical incident technique. This technique provides that an incident be defined, in this case a task, and a series of questions be developed to uncover the attributes and characteristics of the information the respondent used relative to the incident. To provide a basis of analysis of the details of the critical incident, further questions were developed to gain insight into the respondent's background and into some of his general information gathering habits.

Each task used as the critical incident for the interview met the following criteria:

(a) It was at least eight hours in duration.

(b) Some technical consideration was involved in the task.

(c) It had a tangible, clearly identifiable output such as a technical report or an oral briefing.

(d) It was the respondent's most recently completed task that met the above three criteria.

The last criterion, that the task must have been completed, may have resulted in a biased selection of tasks in that a disproportionate number of shorter tasks are likely to have been selected.

(4) Simplification of Recording Techniques

A fourth development trend was the attempt to simplify the interviewers' recording and reporting procedures. The largely narrative recording techniques of the early, loosely structured interviews required lengthy transcribing and analysis by the interviewer after he finished talking with the respondent. The provision of additional structure allowed the interviewer to record responses on the guide itself by entering a single letter or number in a block. The simplified recording and reporting procedures reduced the average "after-interview" cleanup time from an hour or more to only a few minutes. It very likely increased the validity of the returns.

(5) Elimination of Current Awareness Questions

Another development was the elimination of specific questions on the subject of current awareness. During an early analysis phase of the pilot study it was recognized that unique problems existed in gathering accurate data concerning the acquisition and use of current awareness information. These problems are due to the fact that current awareness information is extremely encompassing and is gathered and used in highly subjective ways. Hence, to gather accurate, comprehensive information concerning current awareness, a series of close-up, intensive studies would be required where the investigators would have to "live with" the RDT&E groups. It was further concluded that specific treatment of current awareness would be inconsistent with the critical incident technique used to identify task related retrospective search patterns. Therefore, with the concurrence of the contract monitor, it was agreed that the identification of general current awareness patterns would not be handled within the study.

A.2.3 Interviewer Training

(1) Staffing. The AUERBACH team assigned to the DOD study consisted of a principal investigator, project supervisor, project engineer, analyst, training specialist, and interviewers. In addition, consultants both within and outside the organization were used. The consultants from outside AUERBACH were: Dr. Robert Sleight and Mr. Kenneth Cook of the Applied Psychology Corporation; Dr. John de Cani of the Statistics Department at the University of Pennsylvania; and Dr. Herbert Menzel, a researcher in information use patterns, from Columbia University.

(2) Training. The training program provided schooling for four classes of interviewers: Class I, four AUERBACH interviewers; Class II, four National Security Agency interviewers; Class III, one additional AUERBACH interviewer; and Class IV, two backup interviewers from AUERBACH.

The four members of Class I received an invaluable orientation in previous user study research when they collectively conducted a literature reference search and compiled a very comprehensive bibliography which comprises part of the bibliography in Volume II. In addition to receiving guest lectures from information specialists at Esso and Du Pont, the members of Class I received formal classroom training principally on interviewing techniques; the DOD organizational structure; how to make a literature search; the philosophy, objective, and hypotheses of the DOD study; meanings of

interview guide questions and how to use the guide; interview recording and reporting procedures; and other administrative matters. The bulk of the training time was spent on demonstration interviews using the role-playing method, and in numerous "live" practice interviews conducted at AUERBACH and at DOD installations in the Washington, D.C. and Philadelphia areas. The "live" practice interviews conducted by the regular interviewers were observed by either the training specialist, the analyst, the project engineer, or project supervisor. The interviewer always received a critique of his performance from one or more of these observers. The interviewer's performance in completing the interview guide was also thoroughly analyzed. Additional and significant training was received on-the-job when the interviewers improved their techniques during the pre-pilot and pilot interviews. They also gained insight by assisting in the analysis of pre-pilot and pilot study results, and providing assistance in the revision of successive drafts of the interview guide. The formal training concluded with a field trip to the Defense Documentation Center at Cameron Station, Virginia.

Class II (the four NSA interviewers) received similar training, except that it was condensed into a two-week period. Classes III and IV (one and two interviewers, respectively) were conducted more on a tutorial basis because of their size, but again, the training was almost identical in content. The two-week course for Class II, which formed the pattern for the following classes, consisted of four days of formal classroom training (including demonstration interviews), and five days of practice interviewing in the field, under observation of the trainer and usually one other student. Class IV, unlike its predecessors, was not able to tour DDC on the last day.

Class I naturally did not have the benefit of a completed handbook at the beginning of its training. However, the final drafts of the guide and handbook were available for all the following classes to study as they proceeded through their schooling.

A.3 THE SAMPLING PLAN

It was decided early in the study that a simple random sample of between 1,200 and 1,800 people would be selected and interviewed. Other sampling methods may, no doubt, provide more precision, if more information upon which to base a decision about the population were available. There was, however, not enough readily available information about the population to justify a different approach. The time and expense of collecting additional information were not considered justified for an initial study. It was therefore decided that a simple random sample would be used

with the understanding that it would probably provide, along with other results of the study, information which would be useful in future studies and would provide information leading to sampling plans having more precision.

The population to be studied was defined by DOD and was furnished in the form of punched cards or on typed lists. Generally, each card contained the individual's name, his serial number (if military), his grade, his organization, and a number identifying his professional field. In the case of civil service personnel this latter number is listed in the "Handbook of Occupational Groups and Series of Classes Established Under the Federal Position-Classification Plan" prepared by the United States Civil Service Commission, Bureau of Programs and Standards, Standards Division, and is available from the Government Printing Office. The equivalent information for officers and enlisted men in the three military departments is available in other publications.

Names which were furnished on typed lists were keypunched, and all cards were then printed out with a sequence number assigned to each name. The total list was comprised of 36,000 names. The next step was to obtain random numbers upon which to base the sample selection. The Rand Corporation publication, "A Million Random Digits with 100,000 Normal Deviates," contains random digits conveniently arranged in five-digit numbers; 3,000 random five-digit numbers smaller than 36,000 were selected from this source and then each number was keypunched. The cards were then sorted, placed into numerical order, and printed out. This procedure identified duplicates, and after rejecting them, about 2,700 sample cards remained, which are hereinafter referred to as the first-stage sample.

At this stage the question arose as to how well, from a geographical standpoint, the first-stage sample numerically represented the population from which it was taken. The percentage of the population located at the various installations, or, in some cases, a generalized geographical area containing numerous installations, was calculated. The percentage of the sample at the same installation or area was also calculated and the two percentages compared for each location. In all cases the difference between the two percentages was less than one percent, indicating that the sample could be considered to be representative of the population from which it was taken within the parameters selected.

After determination of the first-stage sample, a card was punched containing the sequence number of the individual, his grade, job code, installation or area code,

and military department. The cards were then sorted by installation or area code to facilitate scheduling and were then printed out. Other sorts were printed out, such as the distribution of job codes within grades and the distribution of grades within job codes, for later consideration.

The second stage of the sampling procedure involved selecting, by random means from the first stage sample of approximately 2,700 cards, one half of the names at each installation or area, yielding approximately the 1,375 names required. Substitute names for missed interviews, due to people being transferred, retired, deceased, or unavailable for any reason, were selected randomly by installation from the residue of the first-stage sample.

The study contract stated that between 1,200 and 1,850 persons were to be sampled. The actual number of interviews performed was 1,375. It is desirable to know how well this sample's characteristics represent the actual population's characteristics. This is found by calculating the maximum standard deviation for the sample size and using the fact that in 95 percent of the items, the sample's characteristics will differ from the population's by no more than $2\sigma_{max}$.

The standard deviation for a simple random sample from a population of size N, and sample size μ is given as

$$\sigma = \sqrt{\frac{N - \mu}{N - 1} \quad \frac{P Q}{\mu}} \quad \text{and}$$

is maximized when $P = Q = 1/2$.

N, the population size, is 36,000 and μ equals 1,375. Therefore

$$\sigma_{max} = \sqrt{\frac{36000-1375}{36000} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{1375}}$$

$$1.32 \times 10^{-2}.$$

Hence, 95 percent of the time the sample's characteristics will differ from the actual population's characteristics by no more than 2.64 percentage points ($2 \cdot \sigma_{max}$). This is considered to be a conservative upper bound.

A.4 THE SURVEY

A 4.1 Method of Operation and Control of the Main Survey

A preliminary trip schedule based on an expected rate of three interviews per day was established for each interviewer at the start of the main survey, and specific dates and times were scheduled for each respondent about a month in advance of each trip.

In scheduling interviews, each interviewer spent two consecutive weeks in the field and returned to the office every other Friday for administrative purposes and for a group briefing which involved a two-way exchange of information between the interviewers and the project analyst and the project engineer.

About a month prior to visiting an installation, the commanding officer was advised by letter of the study and of the proposed interviews. He was furnished a copy of the schedule, and his assistance in enabling the interviewer to carry out the proposed interviews was solicited. At first, a letter was addressed to each respondent advising him of the study and the proposed date and time of the interview and requesting him to advise the project engineer whether or not the interview could be conducted Some difficulty was experienced due to inadequate addresses; consequently, letters to the respondents were later forwarded as an enclosure to the letter sent to the installation commander, with a request that he forward them to the addressees.

Interviewers also experienced difficulty and lost time during the first five or six weeks of the main survey because official notification of the study had not reached many of the installation commanders. It is interesting to note that during this period about 80 percent of the scheduled interviews were conducted, and during the next few weeks this percentage climbed to 90 percent. Another important factor contributing to this degree of success was the publicity given to the study through semiofficial news media.

Two news stories were distributed to the services for publicity in the appropriate media. The first one was a general story about the purposes of the study. The second was more specific, dealing with the content of the interview and identifying both the respondents and the interviewers at specific installations.

To avoid statistical bias by permitting the installation to provide substitutes for unavailable respondents, the schedule included a few alternates who would normally be interviewed on a subsequent trip. In some cases the interviewer was able to reschedule

interviews after arriving at the installation, so as to take into consideration last minute schedule changes. When a person was unavailable and unable to be rescheduled by the interviewer during his visit at a particular installation, a missed-interview report was submitted and the person was rescheduled for a subsequent visit at that installation. Persons who were transferred, deceased, retired, or unavailable for similar reasons were considered to be removed from the population and substitutes were selected from the first-stage sample.

At installations where there were more than 15 persons to be interviewed, two or more trips were made over an extended period of time so that persons not interviewed during earlier visits could be scheduled on subsequent trips In addition, the master schedule for the main survey left open the first two weeks in October for all interviewers, and the last two weeks in September for several interviewers, in order to reschedule as many as possible of those individuals who had been missed.

Occasionally a respondent would write or telephone and assert that he should not be interviewed because he was not a member of the DOD RDT&E population. In some cases, a supervisor took exception to the selection of a particular individual for interview on the grounds that he was too new on the job, or otherwise too inexperienced, and therefore, he recommended a substitute. In such cases, it was explained that, in order to maintain statistical purity, such individuals should be interviewed and accounted for in the analysis of the study. Table A-1 shows some statistics in connection with scheduling interviews.

A.4.2 Special Study of Parts Selection and Application Data

Prior to starting the main survey, a special survey was performed for the Office of Engineering Management, Director of Defense Research and Engineering which was concerned with special needs for parts selection and application data. The interview guide developed for the DOD User Survey was modified slightly, and the persons interviewed were selected from several Defense Department contractors in the Washington area, as well as from DOD agencies also in the Washington area.

In addition to the principal purpose of this study, it was concluded that the general interview technique, which was developed by utilizing the critical incident, would be a suitable method for isolating the information requirements for parts selection tasks. The critical incident approach consists of identifying an incident, such as a task, and asking a series of questions to uncover attributes and characteristics of the information respondents used in the task.

Week Ending	Interview Time in Man-Days	Cum. Number	No. of Interviews Per Man-Day	No. of Interviews	Cum. Number	Cumulative Interviews Per Man-Day	Percent of Succ. Int.	Cumulative Percent of Successful Interviews
1 May 64'	22	22	2.2	48	48	2.2	80	80
8	18	40	2.3	41	89	2.2	78	79
15	21	61	2.2	46	135	2.2	79	79
22	17	78	2.4	41	176	2.3	79	79
29	21	99	2.2	46	222	2.2	77	77
5 June	25	124	2.3	58	280	2.3	90	80
12	24	148	2.7	64	344	2.3	89	82
19	17	165	2.6	45	389	2.4	90	84
26	25	190	2.6	66	455	2.4	88	83
3 July	22	212	2.9	63	518	2.4	100	85
10	15	227	2.7	40	558	2.5	89	85
17	19	246	2.7	52	610	2.5	91	86
24	20	266	2.5	50	660	2.5	94	87
31	19	285	2.5	48	708	2.6	87	86
7 Aug	24	309	2.8	67	775	2.6	94	87
14	20	329	2.8	55	830	2.6	96	87
21	20	349	2.6	52	882	2.6	88	87
28	21	370	2.6	55	937	2.6	89	87
4 Sept	22	392	2.8	62	999	2.6	89	87
11	14	406	2.6	37	1036	2.6	88	87
18	20	426	2.9	58	1094	2.6	89	88
25	21	447	2.5	52	1146	2.6	85	87
2 Oct	24	471	2.6	63	1209	2.6	86	87
9	20	491	2.4	48	1257	2.6	94	88
16	18	509	2.7	49	1306	2.6	96	88
23	17	526	2.7	46	1352	2.6	92	88
30	12	538	2.2	27	1379	2.6	79	88

Note:	The total number of interviews shown should be adjusted for a net deletion of four reports resulting from defective reports and from reports done prior to 1 May 1964	1379 -4
	Number of interview reports analyzed	1375

TABLE A-1. STATISTICS OF INTERVIEW SCHEDULES

A detailed report of this study resulted in AUERBACH Technical Report 1151-TR-2, Report of Special Needs — Survey for Parts Selection and Application Data, April, 1964.

A.5 DATA COMPILATION AND ANALYSIS

A.5.1 Introduction

This part of the study consisted of the following steps:

(1) Data preparation: studying, editing, analyzing, and preparing the interview reports received from the field for computer processing.

(2) Preparation of computer programs to perform data processing, format generation, and selective search of data.

(3) Detailed analysis of the results of the survey.

The first step, data preparation, was performed after interview guides were filled in and submitted to a centralized collection point at the Corporation's facilities in Philadelphia. The process started when each guide was analyzed for such factors as completeness of data, clarity, and unambiguity in terminology. If any items could not be resolved by the analyst, it was promptly returned to the respective interviewer for resolution. Since the guides were submitted to the central collection point at the end of each week, the information never became so old that it could not be accurately resolved. Following the acceptance of a guide, the information was prepared for handling on both the IBM 1401 and 7044.

A.5.2 Computer Programs. (Refer to Section V of Volume II for a More Comprehensive Description.)

A versatile computer program capability was developed for generating the following outputs:

(1) A simple distribution of the responses to individual questions.

(2) The same as item (1) except that certain classes of responses to individual questions are combined or pooled to reduce the table size in order to simplify the analysis.

(3) A frequency distribution of the responses to one question as distributed within the responses to another question for a set of specified pairs of questions. These are displayed in matrix form with row and column percentages shown. (Refer to Figure 3-1.) In addition each cell contains a percentage based on the row total and a percentage based on the column total. Rounding errors are shown for each row and for each column.

(4) The same as item (3), but with pooled responses. The computer program is sufficiently flexible so that either the same questions, a different set of questions, or some combination of questions may be handled on a pooled basis using the tabular arrangement described in item (3).

(5) A series of three-way tables giving the responses to a pair of questions as distributed against the responses to a third question.

(6) Some reduced three-way distributions. In this case, only certain preselected responses are printed out from the set of all possible responses to the questions.

(7) A printout of all the narrative responses to certain questions.

In addition to the above printouts, the computer program has the capability of printing out all but one specified response to a given question, either singly or in combination with other questions. In such combinations, one response may be excluded from each of the questions concerned. Another capability of the program is to print out all serial numbers for those interview reports having specified responses to as many as three specified questions. The purpose of this feature is to enable a researcher to identify and study interview reports with specific characteristics or to have a printout of certain narrative portions of certain questions.

A selected portion of all the tables is included in Section VI of Volume II of this report. A completed list of the various questions which have been printed out is also contained in Section VI

A.5.3 Analysis Procedure

(1) Use of Chi-Squared Tests. As mentioned earlier in the report, two-way tables of the type used in this study may or may not be amenable to standard statistical tests of significance. This depends upon whether the two questions being considered are independent. In the questions which are concerned with "chunks" of information, statistical testing was not used. This is because, by definition, they are dependent upon the characteristics of the task.

In selected cases, where the questions are not concerned with "chunks," the tables were subjected to standard chi-squared tests at the 95 percent confidence level to determine whether or not a statistically significant relationship existed between the classes of the two questions involved. An alpha of five percent (the probability of a class I error - i.e., rejecting a true hypothesis) was selected and is considered to be adequate.

(2) Objective Analysis. Analysis of the other tables used the following procedure:

(a) All row and column marginal percentages were examined.

(b) Those rows and columns that represented five percent or less of the total population of the table were ignored.

(c) A bracket of plus or minus 50 percent of each remaining row and column marginal percentage was established. Each cell percentage was then compared with its associated row and column marginal percentage, and if it were outside the bracket, the cell was noted by being circled.

(d) If a row or column marginal percentage were 50 percent or higher, it was arbitrarily established that the critical range would be 20 percent above and below that value. This critical range or bracket was then used as in item (c).

(3) Subjective Analysis. After the analytic procedure described above had been completed, each table was reexamined by the analyst. The examination at this stage took into consideration the meaning of the two questions. Because of the subjective nature of this stage of the analysis, no specific criteria can be described. Thus, any cell entry that appeared to be out of the ordinary because it was higher or lower than expected was noted. (This is similar to the objective analysis discussed above, except that the significance of the question, experiences during interviews, etc., were now inputs to the analysis) If a heavy diagonal were observed, indicating a strong dependency relationship, or if, based upon the subject of the table, some pattern were significant by its presence or absence, this was noted. After a consideration of these factors comments were made as to the significance or meaning that might be attached to each table.

(4) Summary of Analysis Method. The analysis of the accumulated data was done by using two principal approaches.

(a) The first approach was based upon the quantitative data which was produced by the computer data

compilation programs. Additional quantitative data was produced by using the chi-squared test, where appropriate, plus the procedure described under item (2), "Objective Analysis." These data were used as one type of input to the Subjective Analysis.

(b) The second approach or method of analysis was principally subjective. This was necessarily so because of the subjective nature of many of the survey questions. All of the coded and narrative data was analyzed by subjective and intuitive methods. This was done incrementally over the entire conduct of the study. Each completed interview guide was read, oral feedback from the interviews was evaluated, and the two incremental computer printouts were examined in detail. The incremental analyses served to establish a frame of reference for the analysis of the data produced by the third computer printout. The findings and conclusions of this study are essentially a synthesis and interpretation of those tables, data, observations and evaluations which were found and considered to be the outstanding features of the patterns identified of information acquisition and use within the DOD RDT&E population.

APPENDIX B. DISCUSSION AND RESULTS OF SURVEY QUESTIONS

This Appendix contains the survey data that has been tabulated for each survey question. The rationale and intent of each question are discussed together with the validity and significance that might be attached to the resultant data.

The data obtained in response to each question is presented in tabular form. Each question has a number of answer categories, each of which is identified by letters or numbers found to the left of the category. In some cases, these letters or numbers are in a broken sequence indicating that the categories have been pooled. It was found useful to pool the answers to several closely related categories within a question to produce tabulated data that is more readable and comprehendible. Should a breakdown of the pooled categories or their definitions be desired, the reader is referred to the appropriate question in the Interview Guide and Handbook contained in Section IV of Volume II, to the Glossary of Terms in Volume I, and to Section VI of Volume II, which contains the unpooled distributions.

A number of questions were not applicable to particular respondents (usually in light of the answer to a previous question). For these cases, an answer category of "blank" was recorded, which accounts for the large number of "blanks" found in the tables.

Each table has a "frequency" column. The total in this column may be any of three different totals depending upon the questions. That is, the number 1375 refers to total people or tasks, the number 4687 refers to the total number of chunks, and the number 7790 is the total number of the media from which chunks were obtained. Each table also has a percent distribution column (which may not add up to 100 percent in every case due to rounding).

Questions 6, 13, 19, 24, 30, 44, 55, 57, 58, and 60 provide narrative answers only. The intent of these questions is discussed together with relevant remarks concerning their responses.

B. 1 DISCUSSION OF QUESTIONS RELATING TO RDT&E PERSONNEL

B. 1. 1 Discussion of Questions 1-8

Questions 1 through 8 contain personal data about the DOD RDT&E community. The answers to Questions 1 (Military or GS Rating) and 7 (MOS or Job Code) were verified from information furnished by DOD about the total DOD RDT&E population, and spot checks indicated that the data for these two questions is reliable. Question 6 (Job Title) was not included in the analysis because it was found to contain little or no additional information beyond the responses to Question 7 (MOS or Job Code).

The purpose of Question 3 (Number of Technical Personnel Supervised at Present) was to stratify the RDT&E personnel according to their supervisory responsibility, and to gain insight into the hypothesis that those individuals who supervise others have a unique pattern of information acquisition and use. The data obtained for Question 3 neither confirms nor negates this hypothesis because the answer categories of this question did not prove to be mutually exclusive; i. e., in a significant number of cases it was difficult to assign the answer obtained to a specific category.

QUESTION 1
MILITARY OR GS RATING

		Frequency	Percent
A.	GS05, GS07, 00E2, 00E5, 00E6, Blank	53	4
B.	0001, GS09	111	8
C.	0002, GS11	210	15
D.	0003, GS12	313	23
E.	0004, GS13	326	24
F.	0005, GS14	223	16
G.	0006, GS15	113	8
H.	0008, GS16, C313	26	2
	TOTAL	1375	

The modal rating of the DOD RDT&E community is GS13-0004 and is composed of 85 percent civilian and 15 percent military personnel. The data in this table appears to be normally distributed.

QUESTION 1 (Continued)

Key to Rating

Air Force, Army, & Marines		Navy
0001	2nd Lt.	Ensign
0002	1st Lt.	Lt. (jg)
0003	Captain	Lt.
0004	Major	Lt. Cmdr.
0005	Lt. Col.	Cmdr.
0006	Col.	Captain
0007	B. Gen.	Rear Adm.
0008	M. Gen.	Rear Adm.
00E2	Private	
00E5	Sergeant (Spl 3)	
00E6	Sergeant First Class	
0313	All PL313	

* * * * *

QUESTION 2

YEAR OF BIRTH

		Frequency	Percent
10.	Before 1910	118	9
20.	1911-1920	297	22
30.	1921-1930	488	35
40.	1931-1940	438	32
99.	After 1940	34	2
	TOTAL	1375	

The median age of the DOD RDT&E community is 40 years. Fifteen percent are older than 50 years and 45 percent are 35 years of age or below.

* * * * *

QUESTION 3

NUMBER OF TECHNICAL PERSONNEL SUPERVISED AT PRESENT

		Frequency	Percent
10.	None	693	50
99.	1 - 10	552	40
Blnk.	Over 10, Blank	130	9
	TOTAL	1375	

* * * * *

QUESTION 4

HIGHEST DEGREE AND FIELD

		Frequency	Percent
A.	No degree	137	10
B.	Bachelor in Aeronautical, Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgy, General, and Other Engineering	529	38
C.	Bachelor in Agriculture, Biology, Chemistry, Mathematics, Physics, and Psychology	368	27
D.	Master in Aeronautical, Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgy, General, and Other Engineering	92	7
E.	Master in Agriculture, Biology, Chemistry Mathematics, Physics, and Psychology	133	10
F.	Ph.D. in Aeronautical, Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgy, General, and Other Engineering	8	1
G.	Ph.D. in Agriculture, Biology, Chemistry, Mathematics, Physics, and Psychology	93	7
H.	Medicine	15	1
	TOTAL	1375	

* * * * *

QUESTION 5

YEAR IN WHICH HIGHEST DEGREE WAS OBTAINED

		Frequency	Percent
45.	Before 1945	378	27
55.	1945 - 1954	429	31
99.	After 1954	568	41
	TOTAL	1375	

* * * * *

QUESTION 7

MOS OR JOB CODE

		Frequency	Percent
A.	Biology, Medical Officer	48	3
B.	General Engineering, Civil, Electronic, Aerospace, Marine, Industrial, and Mechanical Engineering	697	51
C.	General Physical Sciences, Physics, Chemistry, Metallurgy, and Meteorology	301	22
D.	Mathematics	82	6
E.	Unknown, Geography, Psychology, Library and Archives, R&D Coordinator (Army), Navigator, and Photographer	247	18
	TOTAL	1375	

It is of interest to note that 13 of the 18 percent of category E represent those individuals who did not know their MOS or Job Code numbers.

* * * * *

QUESTION 8

HOW LONG HAVE YOU BEEN DOING THIS TYPE OF WORK?

		Frequency	Percent
A.	One year and under	219	16
B.	1-5 years	555	40
C.	Over 5 years	601	44
	TOTAL	1375	

The part of this Question "this type of work," refers to the MOS or Job Code classification of Question 7. It can be seen that approximately one in every six persons has been in his present type of work for one year or less. Almost half of the respondents reported they had been working in their present type of work for over five years.

* * * * *

B. 1. 2 Discussion of Questions 9-11

These questions pertain to evaluations by the interviewer of the respondent's comments concerning his work activity. They were developed with the intent of providing a profile of the type of activities within the DOD RDT&E community. The categories in Question 11 are taken from the ASTIA Distribution Guide, dated January, 1961.

The experience in the field with Questions 9 and 11 was excellent because the categories were generally exhaustive, unambiguous, and mutually exclusive. Experience with Question 10 is considered very good; however, in evaluating the difference between research and exploratory development, there was a tendency to classify the respondent into the research category when the choice was not obvious.

QUESTION 9

TYPE OF ACTIVITY

		Frequency	Percent
A.	Detailed scientific or engineering	786	57
B.	Technical evaluation	399	29
C.	Technical administration	158	11
D.	Other	32	2
	TOTAL	1375	

The modal type of activity in the DOD RDT&E community is detailed scientific or engineering work. The category "other" consists of work involving no technical consideration whatsoever.

* * * * *

QUESTION 10

KIND OF ACTIVITY

		Frequency	Percent
A.	Research (and Exploratory Development)	210 (371)*	15 (27)*
B.	Exploratory Development, Advanced Development, Engineering Development, and Operational Systems Development	671 (510)*	49 (37)*
C.	Reliability – Quality Control	47	3
D.	R&D Support	318	23
E.	Other, Blank	129	9
	TOTAL	1375	

This table shows that about one-half of the sampled DOD RDT&E community is performing a development function. The category "other" was used to indicate respondents obviously working in several categories. Narrative comments associated with the "other" category indicate that at least five percent of the nine percent were principally engaged in more than one phase of development. It should be noted that the category R&D support includes computers and associated programming activities.

*If the category Exploratory Development is pooled with Research rather than Advanced Development, etc., the pooled totals for categories A and B would be as shown in the parentheses.

QUESTION 11

FIELD OF ACTIVITY

		Frequency	Percent
01	Aircraft and Flight Equipment	96	7
02	Astronomy, Geophysics, and Geography	34	2
03	Chemical Warfare Equipment and Materials, Chemistry	53	4
05	Communications, Electronics	200	15
06	Detection	64	5
10	Fuels and Combustion, Propulsion Systems	42	3
11	Ground Transportation Equipment, Transportation	15	1
12	Guided Missiles	117	9
14	Materials (Non-Metallic), Metallurgy	46	3
15	Mathematics	31	2
16	Medical Sciences	82	6
22	Ordnance	131	10
25	Physics, Fluid Mechanics, Nuclear Physics	81	6
26	Production and Management	27	2
30	Research and Research Equipment	184	13
31	Ships and Marine Equipment	48	3
34	Electrical Equipment, Installations and Construction, Navigation, Nuclear Propulsion, Photography, Psychology and Human Engineering, Quartermaster Equipment	77	6
36	Military Sciences, Personnel Training, Miscellaneous Arts and Sciences, Blank	47	3
	TOTAL	1375	

Research and research equipment is a catch-all category, and includes the field of computing and programming.

B.2 DISCUSSION OF QUESTIONS RELATING TO RDT&E TASKS

B.2.1 Discussion of Questions 12-14

Questions 12-14 are intended to isolate and define the tasks performed by the respondents. The categories of Question 12, field of task, are identical to those in Question 11, field of activity. Question 13, relating to task output, was an extension of Question 12, but divided into subcategories within each discipline. For example, the term antennas is a subcategory of electronics, and dentistry is a subcategory of medical sciences. Question 13 was not included in the analysis because it was found that the classification was too detailed, and thus segmented the disciplines of the tasks into categories which were represented by too few respondents to be meaningful. Question 14 contains the same categories as Question 10 except that it is used to define the task.

The comments made concerning Questions 10 and 11 also apply to Questions 14 and 12, respectively.

QUESTION 12
FIELD OF TASK

		Frequency	Percent
01	Aircraft and Flight Equipment	77	6
02	Astronomy, Geophysics, and Geography	26	2
03	Chemical Warfare Equipment and Materials, Chemistry	42	3
05	Communications, Electronics	203	15
06	Detection	60	4
10	Fuels and Combustion, Propulsion System	44	3
11	Ground Transportation Equipment, Transportation	9	1
12	Guided Missiles	101	7
14	Materials (Non-Metallic) Metallurgy	49	4
15	Mathematics	27	2
16	Medical Sciences	80	6
22	Ordnance	123	9
25	Physics, Fluid Mechanics, Nuclear Physics	85	6
26	Production and Management	30	2
30	Research and Research Equipment	215	16
31	Ships and Marine Equipment	38	3
34	Electrical Equipment, Installations and Construction, Navigation, Nuclear Propulsion, Photography, Psychology and Human Engineering, Quartermaster Equipment	96	7
36	Military Sciences, Personnel Training, Miscellaneous Arts and Sciences, Blank	70	5
	TOTAL	1375	

The 16 percent figure for tasks in the field of research and research equipment is misleading because it is a catch-all category of disciplines and contains a relatively large number of computing and programming tasks.

* * * * *

QUESTION 14

WHAT WAS THE KIND OR LEVEL OF THE MAJOR OUTPUT OF THE TASK?

		Frequency	Percent
A.	Research (and Exploratory Development)	176 (329)*	13 (24)*
B.	Exploratory Development, Advanced Development, Engineering Development, and Operational Systems Development	683 (530)*	50 (39)*
F.	Reliability — Quality Control	62	5
G.	R&D Support	357	26
H.	Other, Blank	97	7
	TOTAL	1375	

* The comments for Question 10 apply to Question 14.

* * * * *

B. 2. 2 Discussion of Questions 15 and 16

The purpose of Questions 15 and 16 was to determine how tasks were assigned or how they originated. The intent of this data was to be used to confirm or deny the hypothesis that tasks which are self-generated display a unique pattern of information acquisition and use. The data does not permit the acceptance or rejection of this hypothesis because the categories of this question did not prove to be mutually exclusive.

QUESTION 15

WAS THE TASK ASSIGNED?

		Frequency	Percent
A.	Yes	709	52
B.	No	633	46
Blnk.	Blank	33	2
	TOTAL	1375	

* * * * *

QUESTION 16

IF THE TASK WAS NOT ASSIGNED, HOW DID IT ORIGINATE?

		Frequency	Percent
A.	Self-generated	507	37
B.	Joint decision	107	8
C.	Other	22	2
Blnk.	Blank	739	54
	TOTAL	1375	

The Blank category includes all those people who were not asked this question because their task was assigned.

* * * * *

B.2.3 Discussion of Questions 17 and 18

Questions 17 and 18 attempted to determine the duration of a task and the effort exponded on the task by the respondent. The data in the table of Question 17 has been computed by taking the recorded duration of the task and multiplying it by the midpoint of the range specified in Question 18. For example, if a task were recorded as having taken two months (44 work days), and were worked on one-fourth of the time (category B of Question 18), a computation is made (1/4 x 44 = 11 days) which puts the effective duration of the task in the second category of Question 17.

QUESTION 17

MAN-DAYS OF TASK

		Frequency	Percent
005.	1 to 5 days	735	53
022.	6 to 22 days	412	30
132.	23 to 132 days	195	14
999.	over 132 days	33	2
	TOTAL	1375	

The data in this table is produced in conjunction with Question 18 to show the effective duration of the tasks. It is noted that the task selection criteria required the sampled task to have taken at least one full day of time.

* * * * *

QUESTION 18

ON THE AVERAGE, WHAT PERCENTAGE OF YOUR OWN PERSONAL TIME WAS DEVOTED TO THE TASK?

		Frequency	Percent
A.	20 percent or under	347	25
B.	21 percent - 40 percent	277	20
C.	41 percent - 60 percent	268	19
D.	61 percent - 80 percent	211	15
E.	81 percent - 100 percent	243	18
Blnk.	Blank	29	2
	TOTAL	1375	

Over half of the sampled tasks were performed utilizing less than half the person's time. Only 18 percent of the tasks were worked on in what can be considered almost a full-time basis.

* * * * *

B.2.4 Discussion of Questions 19-23

Question 19 requires a narrative answer and is intended to add more information to the description of the physical form of the task output. Experience with this question showed that it was a useful way of aiding the identification of the task output and introducing the next four questions. Questions 20 through 23 develop information about the task output. They were intended to determine whether or not a relationship existed between the form of the task output, and the information used to conclude the task. The data obtained are inadequate to determine whether or not such a relationship exists.

QUESTION 20

WAS THE MAJOR OUTPUT OF THE TASK

		Frequency	Percent
A.	A finding	573	42
B.	A recommendation	500	36
C.	A decision	251	18
Blnk.	Blank	51	4
	TOTAL	1375	

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QUESTION 21

WAS THE MAJOR OUTPUT OF THE TASK

		Frequency	Percent
A.	Oral	286	21
B.	Written	935	68
C.	Other	124	9
Blnk.	Blank	30	2
	TOTAL	1375	

The category "other" contains both oral and written outputs.

* * * * *

QUESTION 22

WAS THE MAJOR OUTPUT OF THE TASK

		Frequency	Percent
A.	Formal	800	58
B.	Informal	552	39
Blnk.	Blank	43	3
	TOTAL	1375	

* * * * *

QUESTION 23

WAS THE MAJOR OUTPUT DIRECTED

		Frequency	Percent
A.	To or within DOD	1154	84
B.	Outside DOD	187	14
Blnk.	Blank	34	2
	TOTAL	1375	

No attempt was made to determine whether outputs directed to or within DOD might eventually be directed outside DOD.

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B.3 DISCUSSION OF QUESTIONS RELATING TO CHUNKS

The concept of a "chunk" is first introduced in the interview in Question 24. The question is designed to stimulate a discussion so as to identify the chunks of information used in the conduct of the previously identified task, and to record narratively a description of each chunk. This question is considered the pivotal one of the entire interview because it sets the stage for the subsequent series of questions about each chunk.

Although the chunk concept is difficult to communicate properly because most people do not view information this way, it is felt that use of this technique was effective and that the data gathered was both exhaustive and generally unbiased.

The tables of data which relate to chunks of information (Questions 25 through 45) contain a relatively large number of blank answers. These blank answers are comprised principally of those chunks of information that were obtained from the respondent's previous knowledge.

B.3.1 Discussion of Question 25

Question 25 represents an attempt to classify information into a set of mutually exclusive categories for the purpose of establishing a criterion for measuring the relative use of different classes of information.

Definitions for each category are described in the Interview Guide Handbook which is contained in Section IV of Volume II. In most cases the interviewer filled out the answer to this question based upon the respondent's answers to Question 24. This procedure was followed to ensure uniformity of the data.

Based upon a composite evaluation by the interviewers and an evaluation of interviews observed by other members of the study team, the field experience and the resulting data from this question are considered to be very good. This positive evaluation results from a complete understanding of the definitions of each class by the interviewers and their ability to implement them uniformly.

QUESTION 25

CLASS OF CHUNK

		Frequency	Percent
A.	Concepts	379	8
B.	Cost and Funding	143	3
C.	Design Techniques, Experimental Processes, Production Processes and Procedures, Utilization, and Test Processes and Procedures	940	20
E.	Math Aids and Formulae	269	
F.	Performance and Characteristics, Specifications	1967	42
H.	Raw Data	215	5
J.	Technical Status	517	11
M.	Other	257	5
	TOTAL	4687	

The classes of information, or chunks, and their frequency of use, which were used by the DOD RDT&E community in completing the sampled tasks, are shown in this table. Several of the categories have been combined, or pooled, since they are closely related. Category C is termed "how-to-do-it" information, and is essentially procedural information. Categories C and F contain information that can be termed "Engineering Data."

* * * * *

B.3.2 Discussion of Questions 26 and 27

Questions 26 and 27 are further attempts to qualify the information developed in Question 24. They are intended to isolate and define the field in which the chunks apply. Question 27 is not included in the tabulation because it was found that the classification was too detailed and thus segmented the disciplines of the chunk into categories which were represented by too few respondents to be meaningful.

QUESTION 26
FIELD OF CHUNK

		Frequency	Percent
01	Aircraft and Flight Equipment	232	5
02	Astronomy, Geophysics, and Geography	73	2
03	Chemical Warfare Equipment and Materials, Chemistry	173	4
05	Communication, Electronics	762	16
06	Detection	165	4
10	Fuels and Combustion, Propulsion System	131	3
11	Ground Transportation Equipment, Transportation	34	1
12	Guided Missiles	284	6
14	Materials (Non-Metallic), Metallurgy	270	6
15	Mathematics	197	4
16	Medical Sciences	203	4
22	Ordnance	304	6
25	Physics, Fluid Mechanics, Nuclear Physics	324	7
26	Production and Management	156	3
30	Research and Research Equipment	801	17
31	Ships and Marine Equipment	92	2
34	Electrical Equipment, Installations and Construction, Navigation, Nuclear Propulsion, Photography, Psychology and Human Engineering, and Quartermaster Equipment	319	7
36	Military Sciences, Personnel Training, Miscellaneous Arts, Blank	167	4
	TOTAL	4687	

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B.3.3 Discussion of Questions 28, 29, and 30

Questions 28, 29, and 30 are concerned with the means (hereinafter referred to as media) by which the chunk of information was conveyed. In many cases more than one media was used to convey a chunk of information. Technical problems arose in determining and recording the actual number of each media used for a given chunk.

Consequently, the data relating to Question 28 is not a reliable measure of the use of different media to convey chunks of information. It does, however, provide an indication of the relative use of the various media.

Question 29 was an attempt to determine whether the media reported in Question 28 were normally used to transmit the chunks described in Question 24. The question was intended to determine whether selected media are used to convey specific kinds of information. The answers were found to be highly subjective, and together with the limitation of the data in Question 28 are of marginal use.

Question 30 is a narrative answer question that attempted to qualify a "no" answer to Question 29. Based upon the subjectivity of Question 29, these results are also of marginal use.

QUESTION 28

MEDIA

		Frequency	Percent
A.	Brochures, Catalogs, Standards and Codes, Drawings, Schematics, Parts Lists, System Specification Documents (QMR, TDP, etc.)	872	11
B.	Oral Contacts with Manufacturer, Oral Contacts-All Other, Meetings and Symposia	2276	29
C.	Live Demonstration, Physical Measurement or Experiment	260	3
D.	Directives, Handbooks, Manuals	579	8
K.	Correspondence, Memos, TWX, Personal Notes, Personal Logs, Personal Files	634	8
N.	Newsletters, Other Mass Media	37	-
R.	Reports and Proposals	1289	17
S.	Texts	446	6
T.	Photographs, Maps, Films	60	1
P.	Pre-Prints, Reprints, Journals	379	5
V.	Previous Knowledge	830	11
W.	Computer Printout	82	1
Z.	Other	46	1
	TOTAL	7790	

The term media refers to the vehicle by which a chunk of information was conveyed or transmitted to the user.

* * * * *

QUESTION 29

DO YOU HABITUALLY USE THESE MEDIA OR PERSONS TO OBTAIN INFORMATION? BY HABITUAL, I MEAN, DO YOU NORMALLY CONSULT THESE MEDIA OR PERSONS WHEN CONFRONTED WITH THE PROBLEM OF OBTAINING THIS (NAME OF INFORMATION CHUNK) KIND OF INFORMATION?

		Frequency	Percent
A.	Yes	3735	80
B.	No	255	5
C.	Information Never Found	20	0
Blnk.	Blank	677	14
	TOTAL	4687	

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B.3.4 Discussion of Question 31

One intent of Question 31 was to determine and to identify the physical arrangement of chunks of information as they were received by the respondents. Another intent of this question was to gain insight into the problems associated with the packaging of information.

Experience in the field and analysis of results show that proper treatment of this subject required a more extensive series of questions than those actually asked. Such questions should consider ways in which information is packaged, and must provide an exhaustive (and lengthy) list of packages with appropriate definitions for each. The date in the table for Question 31 is quite limited because the question is highly subjective, and the definitions for the various categories were neither mutually exclusive nor collectively exhaustive.

QUESTION 31

AT THE TIME YOU OBTAINED THIS (NAME OF INFORMATION CHUNK) WOULD YOU HAVE PREFERRED IT PRESENTED TO YOU IN ANY OTHER MEDIA OR IN ANY OTHER PHYSICAL ARRANGEMENT? (SHOW LIST PER INSTRUCTIONS.)

		Frequency	Percent
A.	No, or no preference	2153	46
B.	Book, bulletin, article, report	1027	22
C.	Informal oral	329	7
D.	Formal oral briefing	81	2
E.	Live demonstration	43	1
F.	Microfilm or microfiche	20	-
G.	Slides or motion pictures	12	-
H.	Correspondence and memos	107	2
I.	Other (Specify)	121	3
Blnk.	Blank	794	17
	TOTAL	4687	

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B.3.5 Discussion of Questions 32-33

Questions 32 and 33 attempt to define and measure the relative exposure to material containing information. They are companion questions and show the difference between the amount of exposure the respondent actually obtained versus the amount of exposure he wanted. Definitions of the categories used in these two questions are contained in the Interview Guide Handbook found in Volume II.

The questions introduce the respondent to the concept that many sources may contain information providing the desired chunk. The amount of material is a relative quantity defined by the respondent with the assistance of the interviewer. The field experience indicates that the data is an accurate measure of the exposure to information. The interviewers found that this concept was easily understood by the respondents and that the categories were exhaustive, mutually exclusive, and well defined.

QUESTION 32

CONCERNING THE TOTAL AMOUNT OF MATERIAL POTENTIALLY AVAILABLE TO YOU WHICH CONTAINS INFORMATION ON THIS CHUNK, HOW MUCH OF IT WERE YOU ACTUALLY EXPOSED TO?

		Frequency	Percent
A.	One item of available material which contains the information	1516	32
B.	A sampling of the available material	1599	34
C.	All the available material	752	16
D.	Nothing	36	1
Blnk.	Blank	784	17
	TOTAL	4687	

* * * * *

QUESTION 33

CONCERNING THE TOTAL AMOUNT OF MATERIAL AVAILABLE WHICH POTENTIALLY CONTAINS INFORMATION ON THIS CHUNK, HOW MUCH OF IT DID YOU WANT TO BE EXPOSED TO?

		Frequency	Percent
A.	One item of material	1611	34
B.	A sampling of the available material	1240	26
C.	All available material	1050	22
D.	Blank	786	17
	TOTAL	4687	

The 17 percent figure which appears in many of the tables concerning chunks is composed almost entirely of those information chunks which the respondents recalled from their own previous experience.

* * * * *

B.3.6 Discussion of Question 34

Question 34 was asked only if the answers to Question 32 or 33 indicated an exposure to a relatively large quantity of information. Consequently, a blank (no answer) was recorded for this question in 81 percent of the cases.

The intent of Question 34 was to determine whether a search aid could have helped the respondent select the information he wanted to read in detail. Sample search aids (a title listing and an abstract) were shown to those respondents who did not understand the meaning of the term "search aid."

Because of the large proportion of blanks, no general conclusions can be drawn as to the use of search aids. It was presumed that those who did not want to see a large quantity of information would not need a search aid. On the other hand, of those who needed a large quantity of information and responded positively to the question, search aids would have been useful or were already being used in 68 percent of the cases.

QUESTION 34

SINCE YOU WANTED TO SEE A LOT OF MATERIAL, WOULD YOU HAVE FOUND TITLE LISTINGS OR ABSTRACTS USEFUL TO READ FIRST IN ORDER TO HELP YOU SELECT THE CHUNK OF MATERIAL TO READ IN DETAIL?

		Frequency	Percent
A.	No, wanted to review all the material — Explain	263	6
B.	Title listings, abstracts, or both	466	10
F.	Already used either or both	155	3
X.	Blank	3803	81
	TOTAL	4687	

* * * * *

B.3.7 Discussion of Questions 35 and 36

Questions 35 and 36 are companion questions intended to determine the amount of time respondents could allow to get needed information, and the time it actually took to get it. Responses to these questions are considered very good because they are relatively straightforward and are easily understood. In some cases the respondent's answer indicated that he could not have proceeded without the information. In these cases the question was considered not applicable.

QUESTION 35

FROM THE TIME YOU REQUESTED THIS CHUNK OR STARTED TO SEARCH FOR IT, WHAT WAS THE ACTUAL TIME IT TOOK TO GET IT?

		Frequency	Percent
A.	No, or Not Applicable	351	7
B.	Under 1 day	1676	36
C.	Under 1 week	735	16
D.	Under 1 month, Under 3 months, Over 3 months	895	19
G.	Received with task assignment	228	5
X.	Blank	802	17
	TOTAL	4687	

* * * * *

QUESTION 36

FROM THE TIME YOU REQUESTED THIS CHUNK OR STARTED TO SEARCH FOR IT, WAS THERE A MAXIMUM TIME YOU COULD HAVE ALLOWED TO GET IT?

		Frequency	Percent
A.	No, or Not Applicable	738	16
B.	Under 1 day	617	13
C.	Under 1 week	998	21
D.	Under 1 month, Under 3 months, Over 3 months	1315	28
G.	Received with task assignment	212	5
X.	Blank	807	17
	TOTAL	4687	

* * * * *

The modal time required to obtain each information chunk was less than one day. The "blank" answers are composed principally of those information chunks that were obtained from the respondent's previous knowledge.

B.3.8 Discussion of Questions 38 and 39

Questions 38 and 39 are companion questions designed to obtain responses about the depth of information wanted and received. The definitions of the categories were clear and the categories themselves were found to be mutually exclusive. The data, however, should be considered in light of the fact that the categories are inherently subjective.

QUESTION 38

WHAT WAS THE DEPTH OF (NAME OF INFORMATION CHUNK) YOU RECEIVED? DID YOU GET A:

		Frequency	Percent
A.	Once over lightly of the subject	859	18
B.	Detailed analysis	1994	43
C.	Specific answer	1002	21
D.	Nothing	42	1
Blnk.	Blank	790	17
	TOTAL	4687	

* * * * *

QUESTION 39

AT THE TIME YOU RECOGNIZED THE NEED FOR (NAME OF INFORMATION CHUNK) WHAT WAS THE DEPTH OF THE INFORMATION YOU WANTED?

		Frequency	Percent
A.	Once over lightly of the subject	700	15
B.	Detailed analysis	2152	46
C.	Specific answer	1043	22
Blnk.	Blank	792	17
	TOTAL	4687	

The depth of the information received and wanted is shown. There is no important difference between the data in the two tables.

* * * * *

B. 4. 9 Discussion of Questions 40 and 41

Questions 40 and 41 were designed to inquire into the physical arrangement of the information chunks as they were both wanted and received. Information from these questions is quite marginal for several reasons. First, the categories are not mutually exclusive; second, the respondents generally were not concerned with the physical arrangement of the information, as long as the information was obtainable.

QUESTION 40

HOW WAS THIS CHUNK OF INFORMATION LAID OUT WHEN YOU GOT IT (NAME OF INFORMATION CHUNK)?

		Frequency	Percent
A.	Information not obtained	27	1
B.	Narrative text; tables or lists; graphical-diagrams, drawings; schematics; flow charts; graphs; maps; photos; graphical and text; graphical and lists	1151	34
I.	Other — Specify	1706	36
X.	Blank	1383	30
	TOTAL	4687	

* * * * *

QUESTION 41

AT THE TIME YOU REQUESTED THE CHUNK OF INFORMATION HOW WOULD YOU HAVE LIKED IT TO BE LAID OUT?

		Frequency	Percent
A.	Information not obtained	93	2
B.	Narrative text; tables or lists; graphical-diagrams, drawings; schematics; flow charts; graphs; maps; photos; graphical and text; graphical and lists	1662	35
I.	Other combinations (Explain) Other — Specify	1806	39
X.	Blank	1126	24
	TOTAL	4687	

* * * * *

The large numbers of "other" and "blank" in both tables indicate that the list of categories in these questions was not sufficiently exhaustive. An analysis of the narrative portions of these questions indicates that there is a wide variety of physical formats both preferred and actually used.

B.3.10 Discussion of Questions 42-45

Questions 42 through 45 are concerned with the first source or organization the respondent contacted in order to obtain each chunk of information identified in Question 24. In the design of these questions, it was clearly recognized that there can be a large number of sources a person eventually contacts in the pursuit of information. However, the first source is considered the most significant because it has the inherent prospects of providing specific and immediate feedback to the interrogator.

Question 42 attempts to define and categorize the many first sources available to the respondents. Information resulting from this question is considered to be excellent for the following reasons:

(1) The concept of a first source was not difficult to transmit to the respondent.

(2) The categories were well defined.

(3) The list of categories was both exhaustive and mutually exclusive.

(4) The question is fairly objective.

Question 43 was an attempt to find out why the first source identified in Question 42 was used. Responses to this question are considered good because it is an easy question for the respondents to understand. The data in this table, however, are considered quite marginal because it was found that the categories were not mutually exclusive.

Question 44 has only narrative answers. It was designed to obtain the actual words the respondent used to interrogate the first source specified in Question 42. Because respondents were unable to recall the exact words they had used, it was not possible to achieve this objective.

Question 45 was designed to qualify and expand upon the information obtained in Question 42. The comments pertaining to Question 42 also apply to Question 45.

QUESTION 42

WHAT WAS THE FIRST ORGANIZATION OR PERSON YOU WENT TO IN ORDER TO OBTAIN THIS INFORMATION?

		Frequency	Percent
A.	Received with task assignment	496	11
B.	Supervisor (if given by Supervisor after assignment), Assignment to Subordinate	268	6
E.	Consultants (Outside), Colleague	1027	22
F.	Librarian or Technical Researcher, Library (Search by Self)	243	5
H.	Department Bookcase or Files	608	13
I.	Own Collection	820	17
J.	Information or Data Centers	19	-
K.	Manufacturer or Supplier	215	5
L.	Blank	991	21
	TOTAL	4687	

* * * * *

In 52 percent of the searches for information, the person first used a local source, such as a colleague, his own files, or local department files. More than half of the 21 percent blank answers are accounted for by information that came from a person's previous knowledge. Libraries and information centers were seldom used as a first source of information.

QUESTION 43

WHAT WAS THE PRINCIPAL REASON YOU USED THE FIRST SOURCE?

		Frequency	Percent
A.	Received with task assignment	534	11
B.	Most authoritative, only source known, availability, previously found helpful	1989	42
E.	Recalled that specific chunk was available from this source	1119	24
G.	Blank	1045	22
	TOTAL	4687	

* * * * *

QUESTION 45

WHAT DID YOU GET FROM THIS FIRST SOURCE?

		Frequency	Percent
A.	All the information	1821	39
B.	Part of the information	1688	36
C.	Reference to further information	307	7
D.	Nothing	86	2
Blnk.	Blank	785	17
	TOTAL	4687	

* * * * *

The majority of the 17 percent figures in the "blank" category of Question 45 is composed of those information chunks that were obtained from the respondent's previous knowledge.

B.3.11 Discussion of Questions 46-48 and 95

Questions 46, 47, 48, and 95 refer to the chunk of information identified in Question 24, and are no longer concerned with the first source.

Question 46 was designed to measure the essentiality of each chunk of information to the completion of the task The data resulting from this question is considered somewhat limited because of the subjective nature of the possible answers. A misunderstanding concerning the implementation of this question tended to inflate the "blank" answers to this question and to Question 47.

Question 47 was designed to establish how chunks were actually used in the task. It was expected that different types of chunks might have different use characteristics. The data, however, did not support this hypothesis.

Question 48 was designed to determine the extent to which relevant and existing information was overlooked during the conduct of a task. The criterion that was established to permit a "yes" answer to this question is explained in the Interview Guide Handbook in Volume II. Essentially, it is a fairly rigid criterion which implies that overlooked data either might, or would, have changed the results of the task.

Question 95 was added after the field survey began in order to qualify the answers to Question 48. It was also intended to be used to test the hypothesis that, as the length of time after the completion of the task increases, there is an increase in the incidence of "yes" answers to Question 48. The data of this question, when compared to Question 48, does not support the hypothesis.

QUESTION 46
WAS THIS CHUNK

		Frequency	Percent
A.	Absolutely essential	3064	65
B.	Could have completed task without it	619	13
Blnk.	Blank	1004	21
	TOTAL	4687	

Those information chunks that the task could have been completed without did not display unique or significant characteristics.

* * * * *

QUESTION 47

WAS THE CHUNK OF INFORMATION USED?

		Frequency	Percent
A.	Directly in the task	3142	67
B.	As background information	730	16
C.	As a lead to other information	7	-
D.	Not at all	23	-
E.	Other - specify	12	-
Blnk.	Blank	773	16
	TOTAL	4687	

* * * * *

QUESTION 48

AFTER THE TASK WAS COMPLETED, DID YOU FIND ANY INFORMATION THAT WAS AVAILABLE BUT UNKNOWN TO YOU AT THE TIME YOU WERE DOING THE TASK?

		Frequency	Percent
A.	Yes (explain)	173	13
B.	No	1148	83
Blnk.	Blank	54	4
	TOTAL	1375	

The narrative comments associated with the 13 percent "yes" answers have no underlying theme as to why information had been overlooked.

* * * * *

QUESTION 95

NUMBER OF DAYS SINCE THIS TASK WAS COMPLETED?

		Frequency	Percent
007	1 week	291	21
014	2 weeks	89	6
030	1 month	164	12
060	2 months	95	7
120	4 months	35	3
999	Over 4 months	17	1
Blnk.	Blank	684	50
	TOTAL	1375	

The large number of "blank" answers is due to this question being added well after the field interviews had begun.

* * * * *

B.4 DISCUSSION OF QUESTIONS PERTAINING TO INFORMATION CENTERS

B.4.1 Discussion of Questions 49-51

Questions 49, 50, and 51 were designed to obtain a measure of the use of TAB and DDC throughout the DOD RDT&E community with the secondary intent of identifying the reasons why DDC was not used.

QUESTION 49

HOW OFTEN DO YOU READ TAB?

		Frequency	Percent
A.	Almost every issue	280	20
B.	Once every 2 or 3 months; no more than once every 6 months	304	22
C.	Never read TAB: does not know of TAB, Blank	791	58
	TOTAL	1375	

The 20 percent figure may in reality be higher because it was found that in many cases TAB was being circulated either in parts or under separate cover by local libraries. Thus, in some cases a person may see TAB regularly but not know it.

* * * * *

QUESTION 50

DO YOU USE DDC (ASTIA)?

		Frequency	Percent
A.	Yes (skip to Question 52)	640	47
B.	No	729	53
Blnk.	Blank	6	0
	TOTAL	1375	

* * * * *

QUESTION 51

WHY DO YOU NOT USE DDC?

		Frequency	Percent
A.	Does not know of DDC	286	21
B.	Physical location; red tape; security; time; poor previous results	43	3
F.	Not relevant	169	12
H.	Other - Explain	232	17
X.	Blank	645	47
	TOTAL	1375	

With the exception of the first category of Question 51, the remaining categories were found to be not mutually exclusive. The narrative comments associated with this question indicate that the chief reason people do not use DDC is because they do not know of its existence.

* * * * *

B.4.2 Discussion of Questions 52 and 53

The intent of Questions 52 and 53 was to obtain a measure of the use of special information and data centers available to the DOD RDT&E community. When it was found that these centers were not utilized, an attempt was made to identify the reasons for the lack of use. To aid in implementing Question 52, each interviewer was given a list of 33 well-known and representative information centers to be shown to the respondent during the course of this question. The list helped to define an information center and to permit the respondent to recall any centers he might have used.

QUESTION 52

DO YOU USE ANY OF THE DOD SPECIALIZED INFORMATION AND/OR DATA CENTERS SUCH AS SHOWN ON THIS LIST?

		Frequency	Percent
A.	Yes (record names) - skip to Question 54	750	55
B.	No	604	44
Blnk.	Blank	21	2
	TOTAL	1375	

* * * * *

QUESTION 53

WHY DON'T YOU USE ANY CENTERS OF THIS KIND?

		Frequency	Percent
A.	Do not know of such centers	255	19
B.	Physical location; red tape; security; time; poor previous results	15	1
F.	Not relevant	184	13
H.	Other - explain	150	11
X.	Blank	771	56
	TOTAL	1375	

The narrative comments associated with this question indicate that the chief reason people do not use information centers is because they do not know of their existence.

* * * * *

B.5 DISCUSSION OF ANSWERS TO MISCELLANEOUS QUESTIONS

B.5.1 Discussion of Questions 54 and 55

Question 54 was designed to inquire into the use of English translations by the DOD RDT&E community. Resultant data is considered unbiased and accurate because the respondents were able to understand the question easily. This question did not establish the last time a translation was used.

Question 55 permits only narrative answers and is intended to expand the "yes" answers obtained in Question 54. This additional data identifies the source that provided the translation. Replies to this question have not been compiled from the interview reports nor subjected to any analysis as part of this study.

QUESTION 54

HAVE YOU EVER USED ENGLISH TRANSLATIONS OR ENGLISH ABSTRACTS OF FOREIGN LITERATURE?

		Frequency	Percent
A.	Yes	764	56
B.	No	603	44
Blnk.	Blank	8	1
	TOTAL	1375	

* * * * *

B.5.2 Discussion of Questions 56-58

Question 56 was used to gather information concerning any difficulties or problems the respondent might have encountered over the last year in obtaining technical information. The criteria used to allow a "yes" answer to be entered is explained in the Interview Guide Handbook. These data can be considered only as an indication of the DOD RDT&E community's satisfaction with their ability to obtain information.

QUESTION 56

DID YOU HAVE ANY SERIOUS TROUBLE OBTAINING OR LOCATING TECHNICAL INFORMATION IN ORDER TO PERFORM OR CONCLUDE THESE TASKS?

		Frequency	Percent
A.	Yes	370	27
B.	No	921	67
Blnk.	Blank	84	6
	TOTAL	1375	

* * * * *

Questions 57 and 58 were asked only if the respondent expressed a problem in obtaining information (a Yes answer to Question 56). These questions sought narrative descriptions of the problems encountered and any proposed solutions. A common problem was obtaining information because of security matters. The most common suggestion from respondents (not necessarily related to the problems of security) was that the DOD publish and distribute a directory or registry of the R&D effort currently underway throughout DOD.

B.5.3 Discussion of Question 59

Question 59 was designed to obtain a subjective evaluation of the respondent's requirement for information not generally available through his immediate local information sources. The evaluation was made by the interviewer according to the criteria specified in the Interview Guide Handbook.

Question 60 permits narrative answers only. It was intended to be used by the interviewer to add any significant comments applicable to the answer given in Question 59.

QUESTION 59

HOW WOULD YOU SUMMARIZE THE RESPONDENTS IN RELATION TO EXTERNAL TECHNICAL INFORMATION NEEDS?

		Frequency	Percent
A.	Has a very large need for external technical information	433	32
B.	Has a moderate need for external technical information	597	43
C.	Has insignificant need for external technical information	330	24
Blnk.	Blank	5	
	TOTAL	1375	

* * * * *

B.5.4 Discussion of Question 93

The intent of this question was to gain some insight into the feasibility of automating certain RDT&E tasks. The answers to Question 93 were determined by the interviewers after the main survey had been completed. These answers were derived from a series of evaluation questions which were added during the field survey plus a reexamination of the completed interview guides.

There was a great deal of difficulty with this question because of the definitions of the categories and the subjective nature of the question.

QUESTION 93

Categories 1 through 4 represent an evaluation as to how well the specific task would fit into a man-machine relationship in the sense that the task might have been programmed and accomplished in some automated fashion. One of the key factors in making this evaluation is to determine the professional knowledge or intellect needed to perform the task.

		Frequency	Percent
1.	Possibly mechanize, low intellect	50	4
2.	Difficult to mechanize, some intellect	430	31
3.	Very difficult to mechanize, considerable intellect required	767	56
4.	Impossible to mechanize, great intellect required	70	5
Blnk.	Blank	58	4
	TOTAL	1375	

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B.5.5 Discussion of Question 94

Question 94 was designed to obtain a method of defining the general output of the tasks. This question represents an evaluation by the interviewer as to the general nature of the task, and is based upon the definitions of the categories used in Question 25. Question 94 was added after the field survey began.

QUESTION 94

EVALUATE AND RECORD THE OUTPUT OF THE TASK ACCORDING TO THE GENERAL DEFINITIONS OF THE CLASSES OF THE CHUNKS

		Frequency	Percent
A.	Concepts	46	3
B.	Costs and funding; administrative action	137	10
C.	Designs or design techniques	211	15
D.	Experimental processes and procedures	63	5
E.	Mathematical aids and formulae; computer programs	94	7
F.	Performance and characteristics	239	17
G.	Production processes and procedures	22	2
H.	Raw data	34	2
I.	Specifications	68	5
J.	Technical status	63	5
K.	Test processes and procedures	66	5
L.	Utilization	23	2
M.	Other; blank	75	5
N.	Evaluation	234	17
	TOTAL	1375	

* * * * *

APPENDIX C. BIBLIOGRAPHY OF USER STUDIES

This bibliography represents the final compilation of references to works pertinent to the User Needs survey conducted by AUERBACH Corporation for the Department of Defense under contract SD-219. It is an updated and expanded version of the Interim Bibliography which was submitted as a part of the first monthly progress report of the study. In addition, it contains many entries from the bibliography prepared for the National Science Foundation (under Grant No. GN-170) by Mr. Richard Davis, of Drexel University; his assistance in providing the survey team with a draft copy of his listing is gratefully acknowledged.

C.1 CATEGORIZATION OF USER STUDIES

In order to provide both effective access to the nearly 700 entries and a means to examine the different types of user studies, a series of categories was prepared to differentiate the studies into two main groups: (1) those of interest to, and useful for, only a small segment of the population, and (2) those applicable to more general aspects of the problems associated with the use and creation of technical information. Each of these groups is further subdivided into subclasses which are discussed and defined in the following paragraphs and which provide access to the bibliography. Table C-1 relates these groups to the bibliography. Not all titles occur, because many of the entries are not directly related to user studies, but concern associated subject matter: problems in Government information, report dissemination and control, interviewing techniques, and so on. Some titles may appear more than once, for these categories are not intended as inflexible classifications. They are, instead, general guides to the contents of the reports, which can both illustrate user study methods and aid the reader in selecting articles of interest for him.

C.1.1 The Limited Interest Category

The studies in this section were restricted in scope and confined to a narrow problem or investigative area. Often they were transitory in interest because they were

addressed to a specific local need. They provided little insight into methodology required for the study of a large and complex community like the Department of Defense.

(1) Studies of Specific Publications

These studies were concerned with single periodicals or small and related groups of periodicals. The purpose was to determine the features of the journal which were well received, the characteristics users would like, the reasons the journal was used, the characteristics of the reading audience, or other similar topics. Though numerous cited studies fall into this group, they are by no means all that exist. Because a great number of serials, popular magazines, and other journals conduct "reader interest" polls, many were not discovered.

(2) Journal Reading Habits of Special Audiences

These studies are related to, but quite dissimilar from, those in the first group. Here, the focal point is an audience selected for certain special characteristics, e.g., all members of the same discipline, or those involved in the same work. With this as a starting point, the studies were related to journals read, or the characteristics of preferred journals, etc.

(3) Journal Reading Habits of Non-Homogeneous Population

These studies were much less numerous than those in groups which were restricted to a specialized group of readers. They were much broader in concept and were often based on a wide range of researchers in a particular community. Often, for correlation purposes, the members were divided into categories by salary, management status, degree, and so forth.

(4) Citation Studies

These studies examined the apparent media preference determined through citations listed in published material. People who publish extensively are, to a degree, a somewhat select group. There is no way of ascertaining exactly why the entry was made in the bibliography. Was it actually needed in the preparation of the paper; was it listed to inform the reader of some earlier similar work or a useful reference; or was it listed simply because the author wanted to establish a relationship between his work and that of others in the field?

(5) Facility Record Studies

These are similar to citation studies, but instead of examining the cited reference work in articles and texts, they examine withdrawal records from libraries, librarians' requests, or requests from special information centers. From this the studies have been applied in two directions: to determine how to improve or build on the information provided by the facility itself, and to determine characteristics about the literature used by that facility's users.

(6) Facility User Studies

These studies examined the characteristics or reading habits of the users of a particular facility. They were generally conducted among students in university libraries and were used to answer such questions as: do good students read more extensively, or do the reading habits of engineers differ from those of English majors?

(7) Studies to Determine Library Use

These studies examined the use made of a library. They determined which areas were used, and how; when browsing was beneficial; and how students used the card catalog.

(8) Studies Soliciting Opinions from Librarians about Users of a Facility

These studies were wholly subjective and depended upon interviews or questionnaires sent to special librarians to learn about the characteristics or "preferences" of a particular facility's users.

(9) Studies Examining the Effectiveness of a Particular System or Piece of Hardware

These studies examined the efficiency of a certain program or piece of hardware in providing the information required by a selected group of engineers. They were very parochial in nature.

(10) Mathematical Models of Certain Aspects of the Storage or Dissemination of Information

These studies, primarily using the results of studies in group (5), developed mathematical tools to calculate the storage parameters, or use of periodicals.

(11) General Subjective Appraisals of Problems

These were not studies in the strictest sense, but rather were evaluations of the information problem, or some aspect or characteristic of users of information, vaguely based on the published results of user studies performed by others. There are numerous examples of these works in the literature.

C.1.2 The More Generally Directed Study

Studies in this category were more broadly applicable to problems in the acquisition and flow of information than those in the first group, and were carried out in most cases with a degree of experimental control. As will be discussed later, however, they were limited by a narrowly or improperly drawn sample, by a faulty methodology, or by the number of questions asked about the use made of the information. Even though neither the methodology nor the data from these works could be employed directly in studying the information requirements of the Department of Defense scientific and engineering community because of their inherent restrictions, these studies did aid in the development of the study methodology insofar as they served as a base to demonstrate where previous work had failed or had gained only limited success.

(1) Media and Information Acquisition Studies

Studies in this area examined principally the media or channel used to acquire information, and were more general than any of the studies identified in Paragraph C.1.1 in that they were not restricted to one journal, one library, one information center, etc. Sometimes the questions were oriented about the media or channel, and sometimes about the user. In either case, most studies in this group looked at one or more of the following topics:

(a) Exposure to information channels.

(b) Time spent reading different media by a small sample of researchers.

(c) Media used or preferred by a selected category of engineers or scientists.

(d) Information channels used or preferred by users.

(e) Evaluation of methods used to acquire information.

(f) The flow of communication among a small sample group.

(g) User skills versus reading habits.

(h) Time spent reading versus productivity or creativity.

(i) Evaluation of information dissemination methods.

(j) Function served by types of media, e.g., current awareness, answer to a question.

(k) Pseudoquantitative estimates of relative value of information gathering methods.

(l) Characteristics of preferred media.

(2) Instructions by Engineers to Aid in the Improvement of Announcement Services

These studies examined in depth the desires of a community for certain types of abstracts, title listings, or other forms of announcement services. They were either corrective in that they evaluated existing services, or implementative in that they asked what type of service would be desired if available.

(3) Means Through Which a Specific Area of Information Was Obtained and Examinations of Preferences for Certain Specific Subject Areas

Studies of this type, which were few in number, chose a special area of information and a specific discipline-related population in order to examine the means through which the information was acquired. One study, for example, offered a short list of subjects in one field and asked respondents which they used most. These studies have looked at extremely limited areas of information and narrowly selected populations, usually confined to but one location.

(4) Reviews of Methodology

Reports on survey methodology, though not user studies in themselves, analyzed the present state of the art in this area and served as a valuable measure of the methods developed by the survey team. Many major reviews have been carried out, of which the most significant is that of the Columbia University Applied Science Laboratory — see Item 460 in the bibliography.

The 15 different categories of user studies discussed above represent a general view of the bulk of studies conducted to this date. More detailed delineation of the categories or characterization of their methodology was not considered essential for this report. If this is desired, it is suggested that the reader refer to Menzel, Review of Studies in the Flow of Information among Scientists, or Bourne, Charles P., Requirements, Criteria, and Measurements of Performance of Information Storage and Retrieval Systems.

C.2 REVIEW OF PREVIOUS STUDY METHODOLOGY

Several basic faults in procedures and techniques prevent the methodology developed by earlier studies from being of value in the study of the vast needs of the Department of Defense. Most studies examined only a fragment population and emphasized but few qualitative measures of the efficiency or characteristics of a media or channel. The Columbia Review of the User Studies[24] considered this fault as being primarily that of developing limited descriptive distributions, or simple cross tabulations, with few attempts at interpretations based on more than one parameter.

TABLE C-1. BIBLIOGRAPHY REFERENCES

Paragraph		References
C.1.1	(1)	15, 16, 18, 21, 24, 43, 95, 160, 165, 197, 273 through 316, 383, 454, 470, 492, 493, 605, 622, 623, 659
	(2)	17, 19, 31, 79, 83, 108, 117, 119, 141, 163, 175, 176, 185, 201 through 204, 221, 262, 328, 346, 369, 378, 413, 487, 494, 562
	(3)	15, 260, 363, 372, 374, 395, 411, 424, 438, 450, 452, 464, 469, 483, 527, 531, 537, 541, 558, 561, 562, 578, 583, 592, 614, 618
	(4)	14, 20, 22, 23, 35, 36, 40, 52, 59, 60, 61, 98, 100, 102, 103, 106, 120 through 123, 138, 143, 154, 155, 169, 171, 178, 221, 230, 231, 232, 239, 240, 248, 268, 269, 272, 320, 330, 331, 332, 343, 360, 361, 364, 392, 393, 402 through 405, 417, 425, 427, 428, 433, 434, 441, 448, 451, 453, 455, 457, 474, 481, 506, 507, 508, 524, 526, 550, 552, 576, 578, 579, 590, 591, 598, 601, 603, 624, 641, 646
	(5)	41, 52, 53, 135, 136, 137, 145, 156, 157, 158, 159, 164, 167, 180, 182, 198, 205, 207, 208, 228, 347, 371, 379, 390, 398, 409, 412, 414, 443, 463, 465, 476, 479, 498, 504, 525, 545, 546, 563, 565, 587, 588, 606, 616, 637, 650, 653, 669
	(6)	125, 146, 147, 163, 174, 191, 205, 206, 212, 235, 318, 337, 338, 370, 396, 436, 443, 465, 480, 496, 497, 502, 505, 527, 537, 585, 587, 606, 625, 668
	(7)	29, 110, 111, 362, 388, 420, 440, 447, 449, 461, 468, 482, 511, 538, 665

Paragraph		References
C.1.1	(8)	81, 118, 131, 196, 209, 244, 553
	(9)	33, 37, 39, 51, 56, 57, 86, 87, 99, 114, 128, 129, 173, 179, 199, 253, 471, 500, 533, 534, 535, 595
	(10)	124, 250, 513, 514, 524, 526, 575
	(11)	5, 7, 12, 13, 28, 32, 44, 45, 46, 49, 50, 58, 63, 65, 73, 74, 85, 91, 94, 107, 109, 113, 359, 475, 533, 534, 535, 548, 571, 580, 652, 656
C.1.2	(1)	2, 4, 25, 26, 27, 67, 68, 70, 72, 76, 77, 90, 105, 115, 116, 130, 139, 140, 149, 161, 172, 181, 188, 193, 194, 218, 219, 227, 238, 241, 242, 245, 249, 259, 261, 263, 322, 323, 344, 348, 350, 351, 365, 366, 385, 391, 400, 416, 438, 444, 445, 450, 453, 458, 464, 469, 471, 475, 503, 512, 531, 532, 533, 534, 535, 541, 547, 551, 555, 558, 561, 570, 578, 583, 589, 592, 597, 603, 614, 618, 619, 620, 621, 630, 635, 636, 638, 645, 657, 658, 670, 676
	(2)	30, 42, 84, 104, 152, 247, 254, 258, 396, 532, 589
	(3)	348, 351, 377, 477, 548
	(4)	91, 162, 458, 459, 460, 551, 570, 575, 586, 599, 600, 607, 609, 610, 619, 620, 644, 645, 656

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APPENDIX D. GLOSSARY OF TERMS

Abstract	A brief summary of the contents of a document.
Age of Information	A measure of up-to-dateness, in conventional units of time, from the present back to the time the subject information was created. This period of time is independent of the age of the media used to transmit the information.
Announcement Journal	A secondary source journal, containing abstracts, titles, indexes, or a combination of all three, which is published as currently as possible with the primary source in order to provide a current awareness service to its readers (e.g., Technical Abstract Bulletin (TAB)).
Bibliography	A published list of references or citations, each of which is relevant to a predetermined topic.
Boolean Statement	A symbolic statement in the algebra of George Boole which expresses logical connections between classes (in the form of AND, OR, and NOT). The statement may be used to formulate an inquiry for the purpose of searching a file.
Chunk	A term referring to a unit of information. Chunks are discrete segments of the total information required in the conduct of a task. A chunk is the smallest unit of task-required information, which would lose its identification and meaning with respect to the task if segmented further. The concept of chunks of information is exemplified by considering chunks as the "pieces" of information required for the solution of a task. Thus, chunks in general then can contain information from a wide variety of subjects; they can be of various disciplines, be found in many media, and be either specific or general.
Class (Of Information Chunk)	A term used specifically in this study to refer to a list of categories of information. This list is part of Questions 25 and 94 in the Interview Guide.
Concepts	Theories, ideas, broad technical plans, or general relationships. For example, the plan for lunar orbit of manned spacecraft preparing to descend to the moon, or the theory of relativity.

Cost and Funding	The allocation or expenditure of money in support of a technical effort. For example, budget data for the coming fiscal year, or for the development of a new land mine.
Critical Incident	A term used in this report pertaining to a technique employed in interviewing. This technique involves isolating and defining a mutually agreed upon event between the interviewer and respondent. In interviewing, this event usually forms the basis for a series of further questions.
Current Awareness	A category of information characterized by aiding a user in keeping up-to-date in a particular field or on a particular subject. Current awareness information tends to assist in maintaining an awareness in the state-of-the-art.
Depth	A term that indicates the specificity or depth of information. In the context of this study, it is a scale for measuring information chunks used, ranging from very specific, i.e., great depth (specific answer) to very general depth (once over-lightly or overview).
Design Techniques	Detailed approaches or procedures employed in combining ideas, and the techniques of converting these combinations into plans and models.
Detailed Scientific or Engineering	(Personnel) who require in-depth technical expertise in a particular area of research, development, test, or evaluation. (Capability) requiring more than just an overview or moderately detailed knowledge of a scientific or engineering area.
Engineering Data	A composite term including the following classes or subjects of information: performance and characteristics, specifications, production processes and procedures, test processes and procedures, and utilization.
Experimental Processes or Procedure	A methodology used to prepare and perform an investigation. Experimental processes and procedures may be generally established ways of either setting up or conducting experiments. An example is the procedure for conducting a wind tunnel experiment to determine the drag on a model of a new supersonic aircraft configuration.
Exposure	A term used in this study which is based upon a relative volume of information available on the subject of a given chunk of information. Exposure is measured in terms of the proportion of the total available relevant information which a user sees or wants to be exposed to.
Field	The 33 fields defined in the ASTIA Distribution Guide, January, 1961. Examples of fields are: Chemistry, Metallurgy, Propulsion Systems, and Transportation.

First Source	The first person, organization, object, or other external source of information consulted by the user in a search for information.
Information Center	An organization which acquires, stores, indexes, analyzes, and synthesizes data and information, usually on a specialized subject.
Information Storage and Retrieval	A term generic to all variations of the problems of storing, locating, and selecting information of any kind, whether it is in graphic or digital form and whether the desired output is a document or a specific fact.
Math Aids and Formulae	Theorems, equations, or empirical formulas accepted as standard information, and used as tools in calculations. For example, the formula for the area of a circle, a constant such as π, fixed tables such as logarithms, or Ohm's law of $E = IR$.
Media	A composite term encompassing all vehicles for information transmission. Examples of media are: journals, oral conversations, drawings, and reports.
Packaging	The physical form in which the information was or could be conveyed. Examples are 4 x 6 microfiche, printed matter, on-line display, and so forth. Media is a major aspect of packaging.
Performance and Characteristics	Observed data or qualities of an object in terms of what it is or how well it performs. Examples are: "high wing monoplane, measured speed of 825 knots," "...a linear function." Performance and characteristics indicate the actual nature or capability of an object, not the design objectives of the object (i.e., not specifications).
Pooled Data	The combination of various categories related to selected questions found in the Interview Guide. The rationale for pooling categories is based upon the experience of the question and the common interest of the categories.
Production Processes or Procedures	The method or sequence of events involved in the production or manufacture of an object.
Raw Data	Unprocessed and uncorrected data which are the primary record of a scientific or technical measurement or event. For example, a graphical record of telemetry data exactly as it appeared when it was radioed from a rocket; a high-speed photograph of the shock waves produced by a projectile.
RDT&E	Abbreviation for Research, Development, Test, and Evaluation.

Retrospective Search	The process of reviewing all present and past information in order to select those items which are relevant to the inquiry which precipitated the search; emphasis is on the quality and completeness of the review and on the presentation of the search product.
Search Aid	Search aids are designed and produced for the express purpose of facilitating the selection or retrieval of relevant information. Examples of search aids are title lists, abstract bulletins, announcement journals, etc.
Specifications	Primarily quantitative descriptions of how well an object is expected to perform. Examples of specifications are: "The proposed aircraft must cruise at 1000 knots.", "...the chassis is to withstand shock of 40 g's.", "...it is required that the computer be able to operate in an environment of -50 degrees to +100 degrees C." Specifications are theoretical expectancies, not what an object is or can do (i.e., performance characteristics).
TAB	Abbreviation for Technical Abstract Bulletin which is an announcement journal published by the Defense Documentation Center (DDC).
Technical Administration	Personnel who spend 90 percent or more of their general work effort in administrative duties rather than as technical contributors.
Technical Evaluation	This classification includes personnel engaged principally in monitoring contractor's technical progress (project offices) or in evaluating proposals. It does not include RDT&E personnel who are engaged primarily in design or research but who may occasionally evaluate projects, plans, or proposals.
Technical Status	The present condition or state of the art in a scientific or technical area or project. For example, a quarterly progress report detailing the accomplishments in the development of a new rocket propellant.
Test Process or Procedure	The method or sequence of events involved in determing the characteristics, capabilities, or limitations of an object which has been produced in quantity. For example, a procedure for conducting desert trials of a production model of an Army tank, or procedures for evaluating durability of common textiles.
Volume	See Exposure.